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SHORT REVIEWS

BIOLOGY

Everyday Biology:
an Introduction to the Study of Life. By Dr. G. Pugh Smith. Pp. xii+283. (London: G. Bell and Sons, Ltd., 1939.) 3*s*. 6*d*.

HERE is a very useful and readable introduction to biology written for young beginners who need a general survey of the subject prior to going into it more deeply for the School Certificate examination. The author has taken the point of view—unfortunately all too rare among authors and teachers of biology—that the subject should relate itself to life and thus teach the reader something about himself. Again, the author takes the refreshing course of opening up with a general review of the plant and animal kingdoms. So many biologies begin with a germinating seed or the detailed study of a plant, which more often bewilders rather than captivates the young beginner. To begin with a general survey of what is already known (at any rate, in part) is undoubtedly the best means of approaching a difficult subject.

The author has broken new ground, even in many of his illustrations, though here he is not so successful. Many are novel and look well, but they teach little. For example, the skeleton is illustrated by three photographs. One is of the "Transparent Woman", which, according to the legend, shows the "skeleton, organs and blood vessels and their relationship to each other". The actual model does this, of course; but the very much reduced photograph shows very little. The other two illustrations are X-ray photographs which will certainly intrigue the young beginner, but will tell him little of the actual anatomy of the skeleton. In the next edition, these photographs should be accompanied by a line drawing. Another excellent, though scarcely helpful, illustration is the photograph of the head of an earthworm which, without the help of the legend, would puzzle many a trained biologist.

In the second edition, the author would be well advised to reconsider certain of the illustrations (so important to any work on biology), and then it would be difficult to better this book for the standard for which it is intended.

Medical Entomology
A Survey of Insects and Allied Forms which Affect the Health of Man and Animals. By Dr. William A. Riley and Dr. Oskar A. Johannsen. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xiii+483. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 25*s*.

WE welcome the appearance of a second edition of this text-book. After an interval of six years much new knowledge has accumulated while older theories and facts have undergone modification. While only seven additional pages are incorporated in this volume, careful reading will show that the revision has been adequate and conscientious. Thus, the account of Latrodectus (or the 'black widow' spider) has been brought well up to date with new illustrations. The role of Phlebotomus in relation to the transmission of kala azar is well discussed, and the conclusion is reached that the insect-vector theory of the transmission of this disease is not borne out as being a major factor in the process.

In the account of mosquitoes an adequate statement of recent work on the biological and other races of these insects seems to be an omission of importance. In dealing with dipterous larvæ as agents in the treatment of osteomyelitis, reference is made to the newest aspect of this method. This involves the use of sterile larval extracts and the isolation therefrom of allantoin or the urea split off during allantoin treatment. In this way a definite advance seems to have been made in overcoming the repulsion aroused by the application of living larvæ to wounds.

In connexion with yellow fever a guarded account is given and a not too optimistic view taken as to its entire elimination from the American continent, owing to the prevalence of the disease in an endemic jungle form. In the great forests of Africa and South America, monkeys and maybe other non-human reservoirs have to be contended with, while various little-suspected species of mosquitoes are probable vectors. At the end of the book there is a supplementary list of literature which brings this aspect of the subject reasonably up to date.

Études et recherches sur les phytohormones

Première réunion organisée en collaboration avec l'Union Internationale des Sciences biologiques, Paris, 1 et 2 octobre 1937. Pp. xiv+126. (Paris: Institut International de Coopération Intellectuelle, 1938.) 35 francs.

IN spite of the great interest in the phytohormones which has been aroused in recent years, their mode of operation and full significance are still far from being fully understood. In the hope of clearing up some of the problems concerning them, and in order to discuss them generally, an international conference of experts who have specialized in the study of phytohomones was held at Paris in 1937. The conference was under the auspices of the International Union of Biological Sciences in collaboration with the International Institute for Intellectual Co-operation. Papers were read by each of the following: Prof. M. J. Sirks (introduction); Prof. F. Kögl (chemistry of phytohormones and other plant growth substances); Prof. Niels Nielsen (phytohormones in different groups of plants); Prof. V. J. Koningsberger (phytohormones and metabolism); Prof. G. S. Avery, jun. (the concept of phytohormones and their relationship to plant irritants); Prof. R. Bouillene (the action of phytohormones on growth, cell division and the genesis of organs); Prof. R. Boysen Jensen (phytohormones and plant movements); Mlle. C. Zollikofer (the influence of animal hormones on plants); Prof. R. Dostal (correlations and phytohormones). The report under review contains each of these papers in full, with an account of the discussions which followed. It is worthy of careful study by all those who are interested in this aspect of plant physiology.

C. R. M.

Methodik der Hormonforschung

Von Dr. Christian Bomskov. Band 2: Ovar (Follikehormone, Gelbkörperhormon), Hoden, Hypophysenvorderlappen. Pp. xxix+1016. (Leipzig: Georg Thieme, 1939.) 89 gold marks.

THE second volume of Bomskov's work on the methods used in research on hormones deals with the sex glands and the anterior lobe of the pituitary. A third volume dealing with the posterior lobe of the pituitary, the anti-pernicious anæmia factor and vasodilator substances is in preparation. This second volume has been produced in a year and a half, and it is easy to believe the author when he says in his preface that it has meant a great sacrifice of personal freedom. The book sets out to describe all the surgical, histological, biological and chemical methods used in the study of hormones. The details are usually given in the form of a direct translation from the original description, so that it is often unnecessary to refer to the original work. There are about 3,000 references, 274 beautifully reproduced figures and 276 tables.

This book will be an invaluable source of information to all workers in this field. It can be criticized on the ground that it contains too many facts. The full description of a number of different ways of doing the same thing necessarily involves a certain amount of repetition but increases the usefulness of the book. The writings of Dr. Bomskov have covered a very wide field (he has written a similar book on vitamins) and it is natural that those whose expert knowledge is deeper, but narrower, should find matter for criticism. Such general reviews do for scientific workers, however, what Baedeker has done for tourists: the traveller finds them very useful, and the settler prefers other sources of information, so long as he is in his own small field.

A Textbook of Pharmacognosy

By T. C. Denston. Third edition. Pp. xvi+583. (London: Sir Isaac Pitman and Sons, Ltd., 1939.) 20s. net.

THIS text-book is primarily intended for the use of students preparing for the chemist and druggist qualifying examination of the Pharmaceutical Society of Great Britain. The subject-matter covers the syllabus for this examination, and is arranged in a systematized, concise manner so that the student can readily grasp it. The drugs dealt with are classified according to their morphological nature under barks, roots, seeds, fruits, etc. This enables the student to compare and contrast similar morphological structures by their macroscopic characters. Microscopy is limited, so as to fulfil the above examination requirements, to starches, calcium oxalate crystals, epidermal trichomes, hairs and fibres used in surgical dressings, and filtering materials. Attention is given to recent work on the identifying and evaluation of drugs, the use of the ultra-violet lamp, methods of cultivation, collection, stabilization, drying, preservation and the detection of adulteration and of insect invasion. Reasons are given for the standards of purity laid down by the British Pharmacopœia.

The illustrations are numerous and of a high order. The drawings set a standard which students would do well to emulate. Both author and publishers have collaborated to produce a volume of which they may justly be proud, and which can be recommended with confidence to those for whom it is written.

W. O. HOWARTH.

An Introduction to Vertebrate Anatomy

By Harold Madison Messer. Pp. xvi+406. (New York: The Macmillan Company, 1938.) 16s. net.

IT is often profitable to present old knowledge in new ways, and this Prof. Messer has done by rejecting the method of teaching zoology by means of selected types and treating the systems of organs from a comparative point of view. The book is a compilation, and makes no claim to originality of knowledge or treatment. But the author maintains that the 'systemic method' is more satisfactory than the 'type-study method' both in the lecture room and the laboratory. The American student taking a one-year course is taught the comparative embryological, histological and anatomical aspects of each system of organs from cyclostomes to man, without, so far as can be ascertained from the book, studying a system in detail in any one animal or relating that

system to the body as a whole. Herein, in the reviewer's opinion, lies the weakness of the method, since the elementary student has no standard or basis for comparison.

The book is well produced and contains some good photographs of stuffed and living animals from museums and zoos. The anatomical figures, however, are of variable quality, many being too small or too faintly drawn, or even so poor as to be misleading. The text, though on the whole well done, is at times inaccurate, perhaps as the result of pushing comparisons too far. A bibliography and glossary are appended. N. B. EALES.

The Molluscs of South Australia

By Bernard C. Cotton and Frank K. Godfrey. Part 1: The Pelecypoda. (Handbooks of the Flora and Fauna of South Australia.) Pp. 314. (Adelaide: Government Printer, 1938.) 7*s*. 6*d*.

THIS book is the tenth in the series "Handbooks of the Flora and Fauna of South Australia". It is purely conchological and deals with the Pelecypoda. There is an introductory chapter on distribution and methods of collecting, and an account is given of the structure of a typical bivalve mollusc. Keys are used for tracing specimens to families, genera and species; but these are based on conchological characters only. The descriptive text is illustrated with good figures of the shells.

The object of this series is to provide Australian naturalists with inexpensive but accurate handbooks dealing with the indigenous flora and fauna. Many of the volumes are pioneer efforts, none more so than this one, for although great collectors like Angas, Tate and Verco have made lists or deposited specimens in the South Australian Museum, no comprehensive account of the bivalves has hitherto been published. The work of these two Adelaide city men deserves the highest praise from every naturalist, and we hope that it will inspire the production of a more scientific treatise on the group, for a bivalve without a body is a mere shell. N. B. EALES.

Population: To-day's Question

By G. F. McCleary. Pp. 222. (London: George Allen and Unwin, Ltd., 1938.) 6*s*. net.

THE author, who as former principal medical officer of the National Health Insurance Commission and medical officer of health of two London boroughs had ample opportunities of studying the various problems of population, has given a lively and lucid exposition of this subject in this little work. The historical aspects are first set forth, special attention, of course, being given to the work of Malthus, followed by an account of the modern methods of measuring the growth of the population. The author then discusses the causes of the great increase in population which began in the eighteenth century and continued until about sixty years ago, when a marked decline in the birth-rate began. Finally, the important subject of birth control receives full consideration, including its social, economic and political results.

CHEMISTRY

The Chemical Formulary

A Collection of Valuable, Timely, Practical Commercial Formulæ and Recipes for making Thousands of Products in Many Fields of Industry. Vol. 4. Editor-in-Chief, H. Bennett. Pp. x+632. (London: Chapman and Hall, Ltd., 1939.) 25*s*. net.

TO the three volumes of the "Chemical Formulary" there has now been added a fourth, in which are to be found many formulæ and recipes gathered together during the past year by members of a large editorial board. This American assembly of useful compounding information, obtained variously from commercial practice and from patent and general literature, covers a very wide range of products ranging from lipstick to lubricants, from concrete to cold cream, from solutions that entice an oyster open to a method for preparing a sulphuric acid catalyst.

In view of the wide application and use of compounded materials of all kinds, the value of a register such as this needs no emphasis. Intelligently used, it conveys a great deal of interesting information, and while it may not in every conceivable case specify the best possible admixture of ingredients for a particular purpose, it will nevertheless save the experimenter much time by presenting him with a reasonable starting point for his trials. The amateur researcher, endowed with that degree of skill, curiosity, and courage requisite for the purpose, will find much to interest him in the sections devoted to cosmetics, to beverages, liquors and flavours, to photography, and to the farm and garden. Engineers and chemists will find particularly valuable such sections as those on materials of construction, paints, soaps, emulsions, adhesives, and inks. The layman who has no intention of putting any of the recipes to a practical test will discover that with the aid of this book he can spend a profitable hour learning something of the composition and application of materials in everyday use. A. A. E.

Lehrbuch der chemischen Physik

Von Prof. Arnold Eucken. Zweite vollkommen neubearbeitete Auflage. Band 1: Die korpuskularen Bausteine der Materie. Pp. xix+717. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 40 gold marks.

THE new edition of Eucken's "Lehrbuch der chemischen Physik" is to be in two parts, of which this is the first. It deals with corpuscles and radiation, and the treatment is on the whole theoretical and mathematical. Several specialists have co-operated in the preparation of sections, some of which are more detailed and difficult than others. The basis is quantum-mechanical. Since the treatment includes molecules, there is a long account of valency. There are also detailed accounts of various types of spectra. The range of subjects is very large, so that a detailed account of the contents can scarcely be given, but the main object is to provide an account

of the modern theories of atomic and molecular structure. The mathematics is, on the whole, of a standard which is within the capacity of an advanced student of physical chemistry, and the book contains a large amount of well-digested information. References to literature are given.

Annual Reports on the Progress of Chemistry for 1938

Vol. 35. Pp. xviii+447. (London: Chemical Society, 1939.) 13s. net.

THE present issue of the "Annual Reports on the Progress of Chemistry", issued by the Chemical Society, contains sections on radioactivity and subatomic phenomena, general and physical chemistry, inorganic chemistry, crystallography, organic chemistry, biochemistry, and analytical chemistry. The plan of dealing with selected topics in some detail is adopted and the reports are interesting and valuable. Of the 410 pages of text, more than 100 are devoted to organic chemistry. This seems a very high proportion as compared with the other six parts of the book, and those responsible for the reports might well consider whether a better balance is not desirable. Some 50 pages on general and physical chemistry cannot be said to reflect the great importance of this branch of the subject.

Kurzes Lehrbuch der physikalischen Chemie

Von Prof. Dr. Hermann Ulich. Unter Mitarbeit von Dr. Kurt Cruse. Pp. xvi+315. (Dresden und Leipzig: Theodor Steinkopff, 1938.) 12 gold marks.

THE distinguishing features of this book are the omission of material which belongs specially to physics and the illustration of the theory by numerical examples. A detailed consideration of the laws of thermodynamics, for example, is replaced by a brief but very clear and instructive discussion of the entropy as a measure of internal disorder, and the formulæ for maximum work and entropy changes are given in a very practical form. The calculations deal with systems of practical interest and are most instructive and helpful. Although the book is short it is in no way superficial or too elementary, and the emphasis is modern throughout. The brief biographical and historical notes add interest to the text.

Particular care is taken to include English and American work, and the English names of functions, etc., are given. The bibliography is very well chosen, and for those students who can read German the book cannot fail to be helpful and stimulating.

The Chemical Analysis of Foods and Food Products

By Dr. Morris B. Jacobs. Pp. xxii+537. (London: Macmillan and Co., Ltd., 1938.) 25s. net.

A GOOD book, full of details which the ordinary inquirer is not likely to find in the usual text-books. It should be on the shelves of every public analyst, and will be found of great use for purposes of reference.

Engineering

Testing Television Sets

By J. H. Reyner. Pp. viii+128+12 plates. (London: Chapman and Hall, Ltd., 1938.) 9s. 6d. net.

THE inauguration of a television service in Great Britain has brought forth a number of text-books, not so much on the theory of the subject as on the very practical question of keeping receivers in effective operation. The complexity in a television receiving set might suggest that the liability to failure is high in comparison with normal broadcasting receivers. The fact is, however, that television sets are much better made, and the anticipated mass-faulting has not matured. The present text-book gives some indication how faults may be chased and put right, but we should not be doing the book justice if we stopped at that, because in illustrating the way in which the elementary parts might misfunction, the author does give much insight into the working of the several parts, so that a technician in a hurry to grasp a formidable subject can get some basic knowledge as well. The text is illustrated with rasters exhibiting typical faults and many clear diagrams. L. E. C. H.

River Engineering: Principles and Practice

By F. Johnstone-Taylor. Second edition enlarged. Pp. xxii+119. (London: The Technical Press, Ltd., 1938.) 4s. 6d. net.

TO deal with a subject such as river engineering within the limits of a small-sized text-book necessarily involves a considerable degree of compression, so that the author has only been able to touch lightly on certain aspects, which might with advantage have been treated at greater length. The explanation of the action of flow at river bends, for example, is rather too superficial to be altogether satisfactory. As a fairly representative outline of the various methods of treatment adopted for the regulation of river channels, the book may serve as a useful introduction to a more detailed study of a difficult science. B. C.

Medicine

Recent Advances in Chemotherapy

By Dr. G. M. Findlay. Second edition. Pp. x+523. (London: J. and A. Churchill, Ltd., 1939.) 21s.

THE series of books published by Messrs. J. and A. Churchill dealing with recent advances in the medical sciences has served a useful purpose and been deservedly popular, but they vary much in form. Some of them contain full reviews on selected topics, giving a readable and connected account of certain aspects of the science with which they deal; others tend rather to consist of abstracts of all the papers published on the subject in the last ten years, and give the impression of having been printed directly from a card index. The latter method of writing provides more information per page but less pleasure for the reader.

The information available on chemotherapy is fragmentary, though extensive, and few generalizations are possible, and the book under notice suffers from fragmentation and compression. Since the first edition appeared, the discovery of the action of sulphonamide derivatives on bacterial infections has opened up great possibilities and caused the appearance of a spate of literature. A new chapter with more than 150 pages which is devoted to this absorbing topic contains an enormous amount of information and greatly enhances the usefulness of the book.

Books on chemotherapy are few, and this one will be almost indispensable to those working on the subject. It contains a large number of references, many of them to papers written in 1938. It is a pity that several of the chemical formulæ are incorrectly printed.

The Extra Pharmacopoeia

By Martindale. Twenty-first edition. In 2 vols. Vol. 2. Pp. xxxvi+1148. (London: The Pharmaceutical Press, 1938.) 22*s*. 6*d*.

THE "Extra Pharmacopoeia" has been produced by the Pharmaceutical Society since the death of Dr. W. H. Martindale in 1933. The twenty-first edition is the first to be completely produced in this way and it is now completed by the issue of volume 2, which is considerably larger than the last volume 2. This volume contains 330 pages of analytical addenda to volume 1; comprehensive information about proprietary medicines, a new section on the nomenclature of organic compounds which contains information not readily available elsewhere; 70 pages of tests on blood and urine; sections on vitamins, milk, margarine, jam and various other foods; preservatives; 135 pages of clinical notes on various diseases; articles on chemotherapy, radium, X-rays, electrotherapy, and much information about chemical tests of all kinds. The book contains a vast amount of information and numerous references to recent medical literature. It has been brought thoroughly up to date and the revision must have involved much work. It will be useful not only to pharmacists but also to biochemists, medical men and analysts.

Classic Descriptions of Disease

With Biographical Sketches of the Authors. By Prof. Ralph H. Major. Second edition. Pp. xxx+727. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1939.) 27*s*.

THE second edition of this fine volume contains nearly a hundred more pages than the first, which was published in 1932 (see NATURE, 131, 895; 1933). In addition to a general revision, new sections have been added on malaria, containing extracts from the works of Hippocrates, Aristophanes, Varro, Celsus, Pliny the Elder, Martial, A. F. A. King and Ronald Ross, and on yellow fever, to the knowledge of which Mathew Carey, Benjamin Rush, Carlos Finlay and Walter Reed, from whose works several passages have been selected, made such valuable contributions.

MISCELLANY

The Science of Society

An Introduction to Sociology. By Dr. J. Rumney. Pp. 125. (London: Gerald Duckworth and Co., Ltd., 1938.) 3*s*. 6*d*. net.

IN these days, few scientific workers can afford to be indifferent to sociology, whether or not they are convinced as to the possibility of a science of society. Even if they are concerned merely in planning in its narrowest technical sense, planning presupposes some understanding of the structure of society and the intimate interrelation between social life and material techniques, and the inability to realize the importance of a sociological approach lies behind many of the gravest difficulties of our time, such as unemployment, the revolt against democracy, mechanized or commercialized leisure, and blind resentment towards science because the benefits it was expected to bring have either not materialized or largely been missed. In this volume, Dr. Rumney indicates for the general reader not only the content of sociology, but also its possibilities as a practical instrument no less than for theoretical purposes.

The sociologist firmly believes that the scientific study of human affairs will ultimately provide a body of knowledge and principles that will facilitate the control and improvement of social conditions. His first task is to determine the range and structure of human society and of social institutions; the second is to investigate the nature of the interdependence of the structures that function in social life; and the third to establish empirical generalizations, or laws of change and growth in social life, and if possible to interpret them in the light of more ultimate laws. Dr. Rumney does not disguise the difficulties in the methods and technique of social study, and he stresses the importance of objectivity and the elimination of bias, as well as the absurdity of expecting the methods of social science to conform exactly to those of the abstract sciences. This brief account is eminently readable, not only for its avoidance of jargon, but also for the admirable way in which it discusses some of the biological aspects of sociology, such as the absurd racial claims sometimes advanced to-day, and the biology of war. Dr. Rumney gives a clear but brief account of the limitations no less than the opportunities of social study, and his book can be heartily recommended to the scientific worker. R. B.

The Consumer-Buyer and the Market

By Jessie V. Coles. Pp. xviii+596. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 17*s*. 6*d*. net.

UP to the time of the great depression in the United States, the average wage-earner there was more concerned with increasing his money income than his real income. During the depression millions of families were forced, in the attempt to maintain customary standards of living on falling incomes, to search for 100 cents' value in every dollar spent. As a result, there has been a steady growth

of interest in the problems of the consumer, and the present volume is a comprehensive study of the difficulties that beset him (or her, as the case may be) in obtaining the desired goods at the lowest price.

The author deals first with the buying habits of the consumer and the structure of the retail market, in which connexion some interesting statistics are given of the comparative costs of marketing commodities by various methods and through various types of shop. Sections on instalment buying and retailers' price policy lead up to the most valuable part of the book, the section on "Market Devices as Aids to Consumer-buyers". After reading this account of the salesmanship, labelling, packaging, guaranteeing, branding and advertising of goods, one is forced to the conclusion that the main purpose of all these 'market devices' is the deception of the consumer. The inadequacy of legislative protection has given rise to such organizations as Consumers' Research, which seeks to provide confidential information on the relative merits of advertised or branded goods. R. W.

A Short History of Science

By Dr. F. Sherwood Taylor. Pp. xiv+320+14 plates. (London and Toronto: William Heinemann, Ltd., n.d.) 8*s*. 6*d*. net.

AN attempt to cover the history of science in some three hundred pages is bound to produce a result which can be criticized from one angle or another. The present book is probably as good an account as is possible in the space. The earlier chapters are of a more general character and will perhaps appeal most to the general reader, but even in the account of the later period, when the material is overwhelming, the author has managed to select with good judgment and to convey the story in a connected fashion. The book is one which should have a wide appeal. The interesting illustrations require special praise.

Philosophy

On Understanding Physics

By Prof. W. H. Watson. Pp. xii+146. (Cambridge: At the University Press, 1938.) 7*s*. 6*d*. net.

IN this work, Prof. Watson thinks aloud about some fundamental concepts and theories of modern physics. He uses for this purpose the analytical method favoured and practised by Dr. Wittgenstein, with the result that many questions, such as those of atomic mechanics and electricity, regarded mainly as mathematical or physical, resolve themselves into logical problems. There is no doubt that science does benefit from a systematic clarification of its language. But is it not going beyond this achievement to separate science entirely from philosophy? Language and symbols cannot go beyond themselves, so to speak, in representing the world of the physicist; but that should be no reason for denying value to *what* is represented. Such a value, of course, cannot be found within the restricted world of linguistic expression, especially in so far as it is applied to technically physical concepts. That is why Prof. Watson's conclusions from his discussion of the idea of substance (ch. v) seem to be beside the point. Nevertheless, the new ground broken in his book makes it a most useful contribution to the philosophy of Nature. T. G.

Symbolism and Belief

By Edwyn Bevan. (Gifford Lectures.) Pp. 391. (London: George Allen and Unwin, Ltd., 1938.) 15*s*. net.

THE philosophy of symbols has become prominent lately through the efforts of mathematical logicians. But it is not with that aspect of the subject which the book under review deals. The author is concerned with the relations between symbolism and religious beliefs. The very character of the data of revelation makes it necessary for man to use symbols for their interpretation and communication. In this respect Mr. Bevan performs a very useful task in explaining, with the support of an amazing amount of scholarship, the purpose of symbolism in these matters. His points would have been strengthened, however, by a bolder theory of analogy. As it is, his book enlightens us, but has little drive in it to guide us towards those truths which underlie his theme. T. G.

Physics

Heat and Thermodynamics

An Intermediate Textbook for Students of Physics, Chemistry and Engineering. By Prof. Mark W. Zemansky. Pp. xii+388. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 24*s*.

THIS text is well suited to the needs of first-year honours students in physics and to students taking a graduate course in engineering. Experimental methods are cut down to the shortest possible presentation consistent with clearness, and modern methods are in most instances selected. Thus, the description of the time-honoured experiments of Joule and of Rowlands for the determination of J is cut down to a few words, and Callendar and Barnes, Jaeger and Steinwehr, and Laby and Hercus appear in their place. Forbes and Angström disappear, and a short account of the modern simple methods for conductivity determinations reigns instead.

Of the two partners in the title, thermodynamics has the lion's share of the space. The treatment is elementary, detailed and satisfactory; unavailable energy is correlated with entropy, and a number of special problems are discussed, including the phase rule. Applications of the Helmholtz and Gibbs functions are made, and a special chapter is devoted to the steam-engine and the refrigerator. Newton's law of cooling is deduced from the fourth power law as holding for small temperature excesses. The fact is, that Newton's law, in the circumstances in which it was established by Newton (*forced* convection), holds, as he showed it to hold, for temperature excesses of some hundreds of degrees.

Each of the nineteen chapters of the book is followed by a comprehensive set of numerical exercises, and the book may be commended as a careful and scholarly introduction to the subject, providing a solid foundation for further knowledge.

Demonstration Experiments in Physics

(Prepared under the Auspices of the American Association of Physics Teachers.) Edited by Prof. Richard Manliffe Sutton. Pp. viii + 545. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 25*s*. net.

THERE are some books that can be reviewed at first reading, others that require only a glance. But sometimes the value of a book can only be appreciated when it has been used for some time, and then comes to be appreciated more and more. The author modestly claims "Demonstration Experiments in Physics" as a 'cookbook' for teachers of physics, and in its 500-odd pages it certainly contains an enormous variety of recipes. Among them we find many already familiar to teachers of physics in Great Britain, but the majority are new, or improved variants of existing experiments. They cover all branches of physics and all stages of lectures; but, naturally for demonstration experiments, the general emphasis is on the first and second years' lectures. Here dramatic nature of the action and simplicity of construction are the chief requirements. The reviewer can vouch for the feasibility of construction and the satisfactory performance of a considerable number of the experiments in this book.

The author and his collaborators have considered very carefully the principles underlying demonstration experiments, and their statement, which starts with the elementary fact so often forgotten that demonstrations are for the student and not for the instructor, is in itself a very useful contribution to the teaching of physics. Any physics teacher who buys this book is likely to find it of ever-increasing use in his lecture preparations.

The Flow of Homogeneous Fluids through Porous Media

By Dr. M. Muskat. With an Introductory Chapter by R. D. Wyckoff. (International Series in Physics.) Pp. xix + 753. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 45*s*.

DR. M. MUSKAT'S book is an important contribution to technical literature and will be useful not only to workers in the oil and gas industries, but also to those who have to deal with problems of fluid flow through refractories and through ceramic materials and with problems of well and dam construction.

The eleven chapters which comprise the book are collected under four main headings. Part I, which deals with fundamentals, is concerned chiefly with a discussion of Darcy's law connecting the rate of flow of water through a filter bed with the area of the sand, the thickness of the bed, and the difference between the fluid heads at the inlet and outlet faces of the bed. The law and its implications are very fully discussed, and the hydrodynamical equations for flow through porous media established. Part 2 deals with steady-state flow of liquids and contains discussions of two- and three-dimensional flow problems, of gravity-flow systems, of systems of non-uniform permeability, of two-fluid and of multiple-well systems. Part 3 is concerned with the flow of compressible liquids through porous media, and Part 4 with the flow of gases through porous media.

The treatment throughout is clear and detailed, and the whole work forms a most useful and praiseworthy contribution to a subject which had, until its appearance, scarcely been explored systematically.

An Introduction to Industrial Rheology

By Dr. G. W. Scott Blair. Pp. xiii + 143. (London: J. and A. Churchill, Ltd., 1938.) 7*s*. 6*d*.

DR. SCOTT BLAIR deals mainly with the flow of non-Newtonian liquids: that is, those whose apparent viscosity varies with the rate of shear. We may regard these cases of anomalous viscosity from either of two points of view: that the anomaly is the interference with the normal hydrodynamical flow of the solvent by the solute particles; or, we may treat the system as a close-packed 'pudding' of particles separated by the dispersion medium. The latter, which is followed in this book, automatically becomes the method of approach of many industrial problems, since these are problems of the 'body' of systems in which the concentration of disperse phase is large. It is certain that, for dilute systems, the coaxial cylinder viscometer is preferable for theoretical reasons which are fundamental and well known.

That this is not made clear in this book is almost inevitable from the treatment followed. Viscosity is described from consideration of flow of liquids through tubes. This leads to Bingham's work on anomalous systems and to the subsequent modifications of his equation. Commercial viscometers are described, but the coaxial cylinder instrument is misnamed 'concentric' throughout the book. Although attention is mainly concentrated on paste type systems, the book contains a wide survey of all the types of anomalous liquid which have been investigated. It should be of value to industrial chemists faced with problems of anomalous viscosity, the number of which increases every day.

A. S. C. L.

The Amplification and Distribution of Sound

By A. E. Greenlees. Pp. 254. (London: Chapman and Hall, Ltd., 1938.) 10*s*. 6*d*. net.

THIS is the first comprehensive text to appear on a subject which the public is rather apt to take very much for granted, the microphone-amplifier-loudspeaker combination, the correct and original description of which is the public-address system. There is little theory which can be said to belong to the subject, except the simple calculations associated with decibels, transformers, and the power-handling capacity of power-valves. The author concentrates on the practical side, perhaps too much, with rather crude descriptions of standard types of microphones and loudspeakers. Nevertheless, he does give a very good picture of the importance of the subject and the extent of its applications.

L. E. C. H.

Technology

An Introduction to the Study of Spinning

By Prof. W. E. Morton. Pp. viii+267. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 12*s*. 6*d*. net.

THE application of the exact sciences to problems of the textile industries has received special attention during this century. The research associations established in connexion with the industry and the Textile Institute, the professional institution of the industry, have contributed much to new methods of thought on textile problems. These organizations, together with the technical institutions responsible for the training of textile students, have created a demand that, as Prof. Morton puts it, the teaching of spinning should be developed on a broader basis.

In his excellent treatise under notice, Prof. Morton has adopted an entirely new method of approach. The book is divided into two parts. In the first part he gives a general survey of the various natural and synthetic fibres, while in the second part he deals with general spinning principles, and points out the modifications in method which the different types of material entail. The book is described by the author as primarily intended as a text-book for use during the first year or two of spinning courses. There is little doubt that in this direction it will have supplied a real need. It is, however, likely to have a much wider appeal, and it will be read by many engaged in the different branches of the textile industry. Its originality of conception and the skill with which it deals with a difficult and extensive subject make it a useful contribution to textile literature.

The Structure of Steel Simply Explained

By Eric N. Simons and Dr. Edwin Gregory. Pp. xi+115+7 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 3*s*. 6*d*. net.

THE subject of the structures of steels is one of very considerable importance from many points of view, and the present volume will be welcomed by many readers. It gives a very clear and intelligible account of the subject and is well illustrated. The treatment is both physico-chemical and practical, the properties of interest to engineers being fully explained as well as the effects of heat-treatment, and many difficult points are elucidated. The book may be warmly recommended. The treatment is 'simple' only in the respect that the authors have taken pains to remove difficulties, and the standard is high. The plates of microstructure are very good, and the properties of special steels receive adequate treatment.

Travel

Saga of the *Discovery*

By L. C. Bernacchi. Pp. xv+240+48 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 10*s*. 6*d*. net.

THIS book is of particular interest since it is written by one of the few whose experiences date from the time when there were no vitamins or radio and when British polar explorers were expected to man-haul their sledges in the way so vividly described. One can well understand the wonder of an expedition to a region which, except for the merest fringe, was new and contained so much of the entirely unknown.

Commander Bernacchi has written of his companions with a sympathetic and notably unbiased pen—a gratifying characteristic—and in spite of his frank recognition of idiosyncrasy one is pleased to observe that he can still write that *Discovery* was a "happy ship". The prejudice against dog-haulage is dealt with, and it is easy to see that it made inevitable the tragedy which involved *Terra Nova's* polar party. It is a dreadful example of the destructiveness of the preconceived idea.

There are a few minor inaccuracies; for example, one may be permitted to doubt whether Killer whales attack adult Blues, since precisely similar stories are told with reference to the Greenland whale.

This is a very readable book and the author is to be congratulated not only for a history of a ship now withdrawn beyond the possibility of further work in the ice, but also for the record of his own experiences in the 'heroic age' of Antarctic exploration.

Siberian Man and Mammoth

By E. W. Pfizenmeyer. Translated from the German by Muriel D. Simpson. Pp. xii+256+24 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 12*s*. 6*d*. net.

DR. PFIZENMEYER here gives an account of two expeditions, of which he was a member, one in 1901–2 and one in 1908, that were sent to Siberia by the Russian Academy of Sciences to excavate the carcasses of mammoths, of which the discovery in a frozen state had been reported. Of these expeditions the first recovered the Bereskova specimen, the most complete hitherto known, and the second the Sanga-Yurakh mammoth, which determined previously uncertain details in the characters of the trunk and tail. The author reviews the history of discoveries of the mammoth since the first recorded report in 1698 down to his own expeditions.

It is somewhat remarkable that these discoveries aroused little scientific interest, and it was not until 1806 that anything like a complete specimen reached St. Petersburg. The character of the tusks was still uncertain, as the native tribesmen usually made a practice, when a carcass was discovered, of hacking out and cutting up the tusks for the sake of the ivory.

The narrative is not confined to the purely scientific objective of the expeditions; and the author gives a vivid picture of travel on horseback and by sledge in pre-Soviet Siberia. He had a sharp eye for the idiosyncrasies of the exiles and tribesmen with whom he came into contact, and gives an interesting account of shamanistic ceremonies and practices. His acute estimate of the potentialities of a country of great natural wealth seems on the way to be realized.

has been arranged as usual in the middle of the supplement, the pagination of which will be unaffected by its removal.

American Geographical Society Awards

ACCORDING to *Science*, the American Geographical Society has made the following awards: Cullum Geographical Medal for 1938 to Emmanuel de Martonne, professor of geography at the University of Paris; Charles P. Daly Medal for 1939 to Prof. H. J. Fleure, professor of geography in the University of Manchester; David Livingstone Centenary Medal for 1939 to John R. Rymill, in recognition of his scientific achievement and exploration in the southern hemisphere. The following have been made honorary members of the Society: Sir Wilfred Grenfell, for his contributions to geographical knowledge concerning the Labrador Peninsula; Prof. H. Baulig, professor of geography in the University of Strasbourg, and Prof. G. Dainelli, professor of geology and physical geography in the University of Florence. The following have been made corresponding members of the Society: E. Antevs, research associate of the Carnegie Institution of Washington; Prof. L. L. Mecking, professor of geography at the University of Münster; W. E. Rudolph, a civil engineer who has carried out extensive explorations in South America; P. G. Schott, retired section chief of the Deutsche Seewarte and honorary professor in the University of Hamburg, and Dr. L. Dudley Stamp, reader in economic geography in the University of London and director of the Land Utilization Survey of Great Britain.

The Night Sky in August

THE moon is new on August 15 at 3·9h. U.T. and full on August 29 at 22·1h. On August 25, ρ Sagittarii (magnitude 4·0) is occulted, the disappearance as seen from Greenwich taking place at 23h. 48·9m. at position angle 77° from the north point of the moon's disk. Conjunctions between moon and planets occur as follows: August 5d. 14h. with Jupiter; 7d. 9h. with Saturn; 26d. 14h. with Mars. On August 25 at 20h. Venus is in conjunction with Regulus, the geocentric distance between the planet and the star being 0·9°. Mars, Jupiter and Saturn rise in the evening, the respective times of southing on August 1 being 23h. 23m., 3h. 55m., and 5h. 20m.; by August 25 these times have changed to 21h. 35m., 2h. 17m. and 3h. 46m. Mars, a conspicuous object low in the evening sky, declines in brightness during the month from mag. −2·5 to −1·8; Jupiter increases slightly from mag. −2·3 to −2·4. Mercury reaches its greatest western elongation (18°) on August 28 and should be looked for in the early morning at about this date. Venus continues as a morning star rising in the dawn at 3h. 26m. on August 1 and at 4h. 38m. on August 25. Saturn reaches a stationary point on August 14, Mercury on August 20, Mars on August 24 and Uranus on August 28. The minor planet Juno is in opposition on August 19, when its magnitude is 8·3; on August 1 it is about 50′ south of α Aquarii. The Perseids reach their maximum frequency on or about August 9, their radiant point being near η Persei. In the late evenings of mid-August, with the moon absent, the region of the Milky Way near the southern meridian offers interesting 'sweeps' with binoculars or telescope.

Announcements

PROF. S. TIMOSHENKO, professor of mechanics at Stanford University, California, has been elected *correspondant* for the Section of Mechanics of the Paris Academy of Sciences.

MR. R. H. WHITBY, City and Guilds College, London, has been awarded the Busk studentship in aeronautics for the year 1939–40 tenable at the Aeronautics Department, Engineering Laboratory, Cambridge.

THE following awards for 1939–40 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company. Fellowships have been renewed in the case of Messrs. A. Cameron (University of Cambridge), H. S. Corran (University of Cambridge) and J. L. Tuck (University of Oxford). Fellowships have been awarded to R. Scarisbrick (University of Cambridge), T. W. Walker (University of London) and J. A. Berriman (University of Cambridge). The Salters' Institute has also awarded forty-four grants-in-aid to young men employed in chemical works in or near London to assist them in their studies.

PROF. OTTO GROSSERN, director of the Anatomical Institute of the German University of Prague, has been awarded the Silver Medal of 1939 by the Jena Society of Medicine and Natural Sciences.

PROF. ESMOND R. LONG, director of the Henry Phipps Institute and professor of pathology in the University of Pennsylvania, has been elected president of the Wistar Institute of Anatomy and Biology. Dr. Edmond J. Farris, associate in anatomy in charge of operations at the Wistar Institute, is to be executive director.

THE twelfth International Congress of the History of Medicine will be held in Berlin on September 22–28, 1940, when the chief subjects for discussion will be the evolution of medicine in different countries from Harvey to Haller (epoch of medical philosophers) introduced by Dr. Laignel-Lavastine, professor of the history of medicine in the Paris faculty, and the history of typhus, introduced by Prof. Zeiss, director of the Institute of Hygiene of the University of Berlin.

AN account of the chemical composition of 'Volpar' contraceptive products recently published (*Eugenics Rev.*, **31**, No. 1) gives many details about the nature and action of these substances. They are in the form of gels and pastes and are weakly alkaline, containing phenyl mercuric acetate in aqueous solution. The gels contain also glyceryl monoricinoleate together with a fungicide to prevent the action of bacteria and moulds. The paste contains a basis of arrowroot starch and can be used in the tropics. Numerous tests of their efficiency and other effects have been made on animals.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 208.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nuclear Reactions in the Continuous Energy Region

IT is typical for nuclear reactions initiated by collisions or radiation that they may, to a large extent, be considered as taking place in two steps: the formation of a highly excited compound system and its subsequent disintegration or radiative transition to a less excited state. We denote by A, B, . . . the possible alternative products of the reaction, specified by the nature, internal quantum state, and spin direction both of the emitted particle or photon and of the residual nucleus and the orbital momentum. Further, we call P_A, P_B . . . the probabilities, per unit time, of transitions to A, B, . . . respectively, from the compound state.

The cross-section for the reaction $A \rightarrow B$ is then evidently

$$\sigma_B^A = \sigma^A \frac{P_B}{P_A + P_B + \cdots}, \qquad (1)$$

where σ^A is the cross-section for a collision in which, starting from the state A, a compound nucleus is produced. This formula implies, of course, that we are dealing with energies for which the compound nucleus can actually exist, that is, that we are either in a region of continuous energy values or, if the levels are discrete, that we are at optimum resonance. Moreover, it is assumed that all possible reactions, including scattering, proceed by way of the compound state, neglecting, in particular, the influence of the so-called 'potential scattering', where the particle is deflected without actually getting into close interaction with the individual constituents of the original nucleus.

On these assumptions a very general conservation theorem of wave mechanics[1] yields the relation

$$\sigma^A = \frac{\lambda^2}{\pi}(2l+1)\frac{P_A}{P_A + P_B + \cdots}, \qquad (2)$$

where λ is the wave-length of the incident particle and l is the angular momentum.

In the case of discrete levels, (1) and (2) give the same cross-section as the usual dispersion formula, if one applies it to the centre of a resonance level and neglects the influence of all other levels. In this case we have for each resonance level a well-defined quantum state of the compound nucleus, and its properties, in particular the probabilities $P_A, P_B, \ldots$ then cannot depend on the kind of collision by which it has been formed, that is, they would be the same if we had started from the fragments B, or C, . . . instead of A.

In the case of the continuum, however, where there are many quantum states with energies that are indistinguishable within the life-time of the compound nucleus, the actual state of the system is a superposition of several quantum states and its properties depend on their phase relations, and hence on the process by which the compound nucleus has been produced.

This dependence is made particularly obvious if we consider the formula

$$\overline{\sigma^A} = \frac{\hbar}{2}\rho\lambda^2(2l+1)P_A^0, \qquad (3)$$

for the mean value of the cross-section over an interval containing many levels, which follows from the well-known considerations of detailed balancing. Here ρ is the density per unit energy of levels (of suitable angular momentum and symmetry) of the compound nucleus. P_A^0 is the probability for process A in statistical equilibrium and thus refers to a microcanonical ensemble of compound states built up from the fragments A, B . . . respectively, with proper statistical weights.

In the case of discrete levels, where formula (3) can also be derived directly from the dispersion formula, P_A^0 is simply an average over the individual levels of the probability P_A, which in this case is well defined.

In the continuum, (3) must be identical with (2), since the cross-section does not vary appreciably over an energy interval containing many levels, and hence, comparing (2) and (3)

$$\frac{P_A^{(A)}}{P_A^0} = \frac{\pi}{2}\hbar\rho\,(P_A^{(A)} + P_B^{(A)} + \ldots) = \frac{\pi}{2}\frac{\Gamma^{(A)}}{d}, \qquad (4)$$

where the superscript A has been added to the probabilities occurring in (1) in order to show explicitly the dependence on the mode of formation, and where $\Gamma^{(A)}$ is the total energy width of the compound state concerned and $d = \frac{1}{\rho}$ the average level distance. In the continuum, where $\Gamma^{(A)} \gg d$, the probability $P_A^{(A)}$ of re-emitting the incident particle without change of state of the nucleus will thus be much larger than the probability of the same process in a compound nucleus produced in other ways.

While the arguments used so far are of a very general character, more detailed considerations of the mechanism of nuclear excitation are required for a discussion of the dependence $P_B^{(A)}$ of the mode A of the compound nucleus provided $A = B$.

One can think of cases in which such a dependence must obviously be expected; in fact, if a large system be hit by a fast particle, the energy of excitation might be localized in the neighbourhood of the point of impact, and the escape of fast particles from this neighbourhood may be more probable than in statistical equilibrium. Further, if the system had modes of vibration very loosely coupled, the excitation of one of them, for example by radiation, would be unlikely to lead to the excitation of a state of vibration made up of very different normal modes, even though the state may be quite strongly represented in statistical equilibrium.

In actual nuclei, however, the motion cannot be described in terms of loosely coupled vibrations, nor

would one expect localization of the excitation energy to be of importance in nuclear reactions of moderate energy. If we suppose that there are no other special circumstances which would lead to a dependence of $P_B^{(A)}$ on A, it is thus a reasonable idealization to assume that, even in the continuum, all $P_A^{(A)}$ are equal to P_B^0, except, of course, for $A = B$, where we have seen in (4) that the phases are necessarily such as to favour the re-emission of the incident particle.

A typical case of a reaction in the continuum is the nuclear photo-effect in heavy elements, produced by γ-rays of about 17 mv. In the first experiments of Bothe and Gentner, there seemed to be marked differences between the cross-sections of different elements, but the continuation of their investigations[2] indicated that these differences can be accounted for by the different radioactive properties of the residual nuclei, and that the cross-sections of all heavy nuclei for photo-effect are of the order of 5×10^{-26} cm.^{2}.

In previous discussions, based on formulæ (1) and (2), where the distinction between $P_A^{(A)}$ and P_A^0 was not clearly recognized, it was found difficult, however, to account for photo-effect cross-sections of this magnitude. In fact, if one estimates the probability of neutron escape P_B at about 10^{17} sec.$^{-1}$, one should have for P_A 10^{15} sec.$^{-1}$, and as long as this was taken as P_A^0 it seemed much too large, since it evidently must be much smaller than the total radiation probability, estimated at about 10^{15}, which included transitions to many more final levels besides the ground state.

We see now, however, that $P^{(A)}$ is here considerably larger than P_A^0, since the level distance at the high excitations concerned is probably of the order of 1 volt, whereas the level width corresponding to the above value of P_B is about 100 volts. From (4), or more directly from (3), P_A^0 is thus seen to be only about 10^{13} sec.$^{-1}$, which would appear quite reasonable.

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[1] The details of this and of the other arguments of this note will be published in the *Proceedings of the Copenhagen Academy*.

[2] Bothe, W., and Gentner, W., *Z. Phys.*, **106**, 236 (1937); **112**, 45 (1939).

The Scattering by Uranium Nuclei of Fast Neutrons and the Possible Neutron Emission Resulting from Fission

THE work to be described concerns only fast neutrons, and its object is the study of their scattering by uranium and the possible neutron emission which accompanies the fission of the nucleus.

The experiments were performed with a polonium plus beryllium source equivalent to 3mC. of radon plus beryllium. An ionization chamber surrounded with 2·5 cm. lead, filled with hydrogen at a pressure of 35 atm., was used as a neutron detector. The insulated electrode was connected to a compensated electrometer valve[1], the grid leak being 10^{11} ohms and the sensitivity $1{\cdot}2 \times 10^{-15}$ amp./div. on the scale.

We have employed two experimental arrangements in which the source was placed (1) between the chamber and the substance used as scatterer, the nature and the thickness of which were variable; (2) in the centre of a cube of 16 cm. side, alternately filled with uranium oxide (specific gravity, $d = 4{\cdot}0$) and lead oxide (compressed to $d = 3{\cdot}8$).

The first type of experiment gave us the total scattering cross-section, which is, as can be shown, $\sigma_t = \sigma_e + k_i\sigma_i$; for uranium oxide $\sigma_t = \sigma_e + k_i\sigma_i + k_r\nu_r\sigma_r$, where σ_e, σ_i, σ_r are respectively the average cross-sections of elastic and inelastic scattering and of fission; ν_r is the average number of neutrons produced per fission; k_i and k_r are the average efficiency factors of the chamber for the neutrons having undergone an inelastic collision or for the neutrons resulting from fission. The efficiency for the direct neutrons was taken to be unity, $k = 1$. For neutrons elastically scattered by nuclei of sufficiently high mass, $k_e = k = 1$. We have calculated k, taking into account the size of the chamber, the cross-section for proton projection, etc. The spectrum of polonium plus beryllium neutrons has been considered[2] to contain 50 per cent of neutrons of W_n less than 10^5 ev. We thus obtain:

$10^{-5}\,W_n$	0·1	0·5	3	5	10	ev.
k	0·3	1	1·9	1·7	1·2	

In view of a possible extrapolation that would give $\sigma_e + k_i\sigma_i$ for uranium, we have in the same way experimented with scattering by lead oxide, lead, copper and zinc.

The results of the first experiment were as follows:

Substance	Cu	Zn	Pb	PbO_2	UO_2	$(O)_{calc.}$	$(U)_{calc.}$
$\sigma_t \times 10^{24}$ cm.^{2} ($\pm$ 10%)	2·2	2·3	5·4	9·5	14·4	2	10·3

The values for uranium and oxygen are calculated on the assumption of the additivity of the cross-sections in lead oxide and uranium oxide.

The second experiment gives us, in the first approximation, the absorption coefficient $(1-k_i)\sigma_i + (1-k_r\nu_r)\sigma_r$, the value of σ_e being only as a correction term in the determination of the mean free path λ and the average distance L travelled by the neutrons before they escape from the whole mass, which is supposed spherical, the radius being r and $L = r\left(1 + \frac{1}{2}\frac{r}{\lambda}\right)$. This experiment, taking into account the results of the previous experiments, gives for lead, $(1-k_i)\sigma_i \simeq 2 \times 10^{-24}$ cm.^{2}. Assuming that σ_i can reach 30 per cent of σ_e[3], this gives $k_i\ (\simeq)\ 0$.

With the exception of uranium, for which one must consider not only σ_i, but also $\nu_r\sigma_r$, it is probable that σ_t is not very different from σ_e because of the small value of k_i.

In the case of uranium, however, we have,

$$(1-k_i)\sigma_i + (1-k_r\nu_r)\sigma_r \simeq 0{\cdot}9 \times 10^{-24}\ \text{cm.}^2 \qquad (1),$$

or, by adding to σ_t, thus eliminating k_i and k_r,

$$\sigma_e + \sigma_i + \sigma_r \simeq 11{\cdot}2 \times 10^{-24}\ \text{cm.}^2. \qquad (2).$$

If it is supposed that each fission produces radio-elements, the cross-section measured by Joliot, and by Anderson *et al.*[4] would be identical with σ_r, which they found to be $\sigma_r \simeq 10^{-25}$ cm.^{2}. In this case we see that $(\sigma_e + \sigma_i)$ is much greater ($\simeq 11{\cdot}1 \times 10^{-24}$ cm.^{2}) than that given by an extrapolation ($\simeq 6 \times 10^{-24}$ cm.^{2}).

On the other hand, it results from (1) that, if the value of σ_i is comparable to that of the next elements (1 to 2×10^{-24} cm.^{2}), ν_r can, with plausible assumptions as to the coefficients k_i and k_r, take variable values, for example, from 1 to 5, or even more.

One can see that, so long as σ_i is not determined separately, the experiments of the type described do not allow us to determine ν_r and σ_r (characteristics of the fission), or to conclude that neutrons are

liberated; or, *a fortiori*, to form a conclusion as to the possibility of chain reactions, contrary to the results of similar experiments[1].

The only suitable case for showing with certainty, by means of an ionization chamber, the production of neutrons, would be that in which, by the use of a sufficient quantity of uranium, the chain mechanism would give multiplication of neutrons, if such chain is realizable[6].

In conclusion, it results from these experiments with neutrons of polonium plus beryllium that the sum of the cross-sections $\sigma_d+\sigma_i+\sigma_\gamma$ for the uranium nucleus is $(11{\cdot}2 \pm 1{\cdot}5)10^{-24}$ cm.[2]. This value implies a mean path in uranium much shorter than that usually admitted; this suggests that smaller masses than those hitherto expected might be used to show chain fission.

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[1] Rogozinski, A., *C.R.*, **208**, 427 (1939).
[2] Auger, P., *J. Phys. Radium*, **4**, 719 (1933).
[3] Seaborg, G. F., Gibson, G. E., and Graham, D. C., *Phys. Rev.*, **52**, 408 (1937).
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[5] Haenny, C., and Rosenberg, A., *C.R.*, **208**, 898 (1939).
[6] v. Halban, H., Joliot, F., and Kowarski, L., NATURE, **143**, 680 (1939). Perrin, F., *C.R.*, **208**, 1394, 1573 (1939).

Possible Delay in the Emission of Neutrons from Uranium

ROBERTS[1] and others have reported the emission of delayed neutrons with a period of 12 sec. from uranium under neutron bombardment, but the effect seems to be a small one[2], the main body of neutrons being produced in a much shorter period. Green and Alvarez have shown that there is no delay exceeding 3×10^{-3} sec. in the actual production of fission, but it seemed possible that the neutrons might not be produced at the moment of fission but rather as the products of rapid disintegration of the primary fission particles.

Following on a conversation with Prof. N. Bohr, we have made experiments to see if there is any appreciable delay (approximately 0·01 sec.) in the emission of the bulk of the fission neutrons. For this purpose we have used the intermittent neutron source described by Moon and others[3]. In this device, neutrons emitted by the intermittent bombardment of a target of heavy ice with deuterons are detected on a cathode ray oscillograph, the time-scale of which is interrupted by marks produced by the intermittent beam of ions. For the present experiment, the detecting chamber was shielded with cadmium and placed nearer the source (about 2 metres instead of 5 metres), thus increasing the intensity and diminishing the lag due to the time of flight of any slow neutrons present. The period of intermittence was 0·005 sec. and delays exceeding 0·001 sec. could have been detected. Delays larger than 0·005 sec. would have resulted in an approximately uniform distribution of the fission particles over the time-scale. Experiments were made by surrounding the source with a considerable thickness (approximately 10 cm.) of uranium oxide (U_3O_8). Check experiments were made without the uranium, and also without the source but with the uranium.

Two complete sets of experiments were made, one with the source surrounded with wax inside the uranium, the other with it bare. The second experiment showed a slight positive effect corresponding to a cross-section of about 5×10^{-29} cm., about that found by Roberts, but this is of the order of the experimental error. We can, however, say that the effect is less than corresponds to a cross-section of 10^{-28} cm., so that it is unlikely that the bulk of the emission is due to effects having a delay of more than 10^{-3} sec. in the case of the primary neutrons from the D—D process. The experiment with the wax gave a negative result, and assuming that the number of 'slow' neutrons emitted from the source, which was surrounded by about 5 cm. wax, is a quarter that of the fast neutrons emitted under the same conditions, we should have detected a cross-section for the production of a delayed neutron of 5×10^{-25} cm. The value given by Anderson and others for fission is 2×10^{-24} cm., and according to Szilard about two neutrons are produced per fission.

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July 17.

[1] Roberts, Meyer and Wang, *Phys. Rev.*, **55**, 510 (1939).
[2] Szilard and Zinn, *Phys. Rev.*, **55**, 799–800 (1939).
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Evaluation of the Beta Upper Energy Limits with Simple Absorption Data

OF late, several methods have been suggested by different workers[1,2,3,4] for estimating the β upper energy limits of radio-elements (especially those produced in artificial disintegrations) from absorption measurements made with aluminium foils. One great drawback of these methods is that most of them are too empirical and without a theoretical basis, and are limited to cases of simple spectra.

A new method is now proposed, which enables one not only to obtain good results, but also to analyse complex spectra into simple ones, from the ordinary absorption data. It consists essentially in utilizing the absorption measurements to construct the Fermi and Konopinski-Uhlenbeck theoretical curves and deduce the upper limit by extrapolation.

As is well known, the Fermi and Konopinski-Uhlenbeck[5] curves have been used for magnetic spectrograph and cloud chamber data. Kurie, Richardson and Paxton[6] first pointed out a practical way of doing this, and many workers have applied it to several cases with success. To plot these curves, two quantities are required, namely, the number N of β-particles in successive small momentum (or energy) intervals, and the average momentum M (or average energy E) for each of those intervals, all along the distribution curve, chiefly in the high-energy portion. Certain simple considerations make it possible to derive these two factors N and M (or E) to a good approximation even from simple absorption measurements. In consequence, absorption data can be used to draw the Fermi and Konopinski-Uhlenbeck curves.

This new method has been applied with interesting results to radiorhodium and radiosilver obtained with slow neutron activation. The two periods of rhodium are supposed to be isomeric, while those of silver are not.

Method	Rhodium	
	45 sec.	4·3 min.
Konopinski-Uhlenbeck	2·70 ± 0·05 Mev.	2·75 ± 0·05 Mev.
Fermi	2·62 ± 0·05 „	2·66 ± 0·05 „

Method	Silver	
	24 sec.	2·5 min.
Konopinski-Uhlenbeck	2·81 ± 0·08 Mev.	1·72 ± 0·05 Mev.
Fermi	2·60 ± 0·10 „	1·67 ± 0·07 „

The following points are worth noting:

(1) The above values are in good agreement with those obtained by different methods[7].

(2) The upper energy limits of the two periods of rhodium are the same within the limits of experimental error, an important result which confirms Pontecorvo's simple scheme[8] for the isomers of rhodium.

(3) For rhodium, besides the above-mentioned two upper limits, a third one is obtained of about 3·8 Mev., which is found always linked with the 45 sec. period. A close comparative study of the curves of rhodium and silver clearly shows that this value cannot be referred to either of the isomeric periods. Various hypotheses, such as 'group' spectra, radioactive rhodium (102), secondary electrons, etc., have been tried to explain it.

The new method has the following advantages over others: (*a*) it has a theoretical basis, namely, Fermi's theory of β-disintegration; (*b*) it enables a complex spectrum to be split up into simple spectra; (*c*) measurements very close to the limiting thickness of absorber are not necessary; (*d*) it is impersonal and objective at the same time, since the upper limit is given by a definite point of intersection of the curve with the X-axis.

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A New Method of Determining e/m for Medium High Velocities

CONSIDER the motion of an electron moving in an electric field between two charged co-axial cylinders. If the electrons are emitted from S (Fig. 1) with velocity v, they can be refocused at a point S' on the circle r_0 if

$$(1)\quad \Theta = \frac{\pi\gamma}{\sqrt{1+\gamma^2}} \text{ where } \gamma = \frac{1}{\sqrt{1-v^2/c^2}}\ ;$$

and further, if the field at the circle of radius r_0 satisfies the relation

$$(2)\quad eF = \frac{m_0\gamma v^2}{r_0}.$$

From (1) and (2) we get

$$(3)\quad \frac{e}{m_0} = \frac{c^2}{Fr_0}\sqrt{\frac{(2\Theta^2-\pi^2)^2}{(\pi^2-\Theta^2)\Theta^2}} \text{ e.s.u.gm.}^{-1}.$$

Thus a simultaneous measurement of the two quantities Θ and F would give a value for e/m_0.

The method becomes much more convenient when a radioactive source is used at S emitting a continuous velocity spectrum of electrons. The angle Θ can then be fixed and it is only necessary to vary the field until a maximum of intensity is observed at S'. The best way of doing this in practice would appear to be to have just a slit at S' and to place the detecting counter at C, approximately a further angle Θ round the centre. This will always be possible, since Θ must lie between $\pi/\sqrt{2}$ and π.

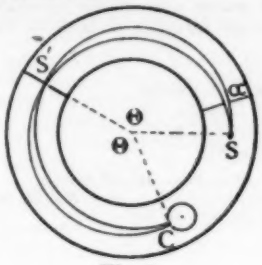

Fig. 1.

In effect, the choice of a definite angle Θ specifies the energy of the electrons for which e/m_0 is to be found:

$$(4)\quad E = \frac{m_0c^2}{e}\left(\sqrt{\frac{\Theta^2}{\pi^2-\Theta^2}} - 1\right)300 \text{ ev.};$$

and so only one deflection measurement is necessary.

The increase of the angle of refocusing Θ with the velocity is a pure relativistic effect and also takes place in a Coulomb field, where the dependence of Θ on the velocity can be found readily from the precession of the ellipse, $\Theta = \pi\gamma$. Owing to the stronger focusing properties of the inverse r field, slow electrons are refocused in this field earlier than in a Coulomb field, and the increase of Θ with the velocity is slower.

The accuracy of the method will depend mainly on the determination of the angle Θ, since

$$(5)\quad \frac{d(e/m_0)}{e/m_0} = \frac{\pi^4}{(2\Theta^2-\pi^2)(\pi^2-\Theta^2)}\frac{d\Theta}{\Theta};$$

and this is very large both at small and high velocities. The error is a minimum for $v/c = \frac{1}{2}\sqrt{6} \doteq 0{\cdot}81$, corresponding to an energy of nearly 10^6 ev., which is certainly an interesting region. The angle Θ is then $\frac{\pi}{2}\sqrt{3} = 155{\cdot}88°$, and under this condition,

$$\frac{d(e/m_0)}{e/m_0} = 8\frac{d\Theta}{\Theta}$$

It does not seem at all impossible ultimately to have the angle Θ measured to 1 part in 10,000, which would lead to an accuracy of 1 in 1,000 for e/m_0. Using an apparatus with $r_0 = 25$ cm. and a gap between the two cylinders of 0·5 cm., 10,000 volts would be required to refocus electrons of this energy.

Apart from the question of measuring the voltage, the error in fixing the exact value of the field to give focusing is determined by the resolving power of the apparatus. If this is too high, other errors would be introduced due to lack of intensity. With a source of 1 mc. on a 0·1 mm. wire, ample intensity should be obtained with an angular spread of $\alpha = 2 \times 10^{-2}$ radians. With these values the uncertainty in dF/F should not exceed 10^{-4}.

Apart from the question whether an accuracy could in fact be realized comparable with that attained already for slower electrons, this method is interesting in so far as it is peculiarly adapted for use with the electrons or positrons forming the continuous spectrum from radioactive bodies.

An interesting analogy exists between this method

and that developed by Henneberg[1], Bartky and Dempster[2] and Shaw[3]. They also use a field between two co-axial cylinders, but since their electrons are very slow, the angle of refocusing is practically $\pi/\sqrt{2}$ and quite insensitive to changes in velocity. An artificial precession is then introduced by a magnetic field parallel to the axis of the cylinders, when the method becomes formally similar to that described here.

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Phosphatide Exchange between Plasma and Organs

THE blood plasma of rabbits contains about 80 mgm. phosphatides. What is the average time a phosphatide molecule spends in the plasma?

To answer this question we administered labelled sodium phosphate of an activity of 0·01 millicurie to rabbit *A*. The active phosphate was kindly presented us by Prof. Lawrence. After the lapse of a day the plasma contained phosphatides of an appreciable activity. We added this plasma to the corpuscles from rabbit *B* and reintroduced the blood obtained, composed of non-active corpuscles and active plasma, into the rabbit *B*. Blood samples were taken at intervals from the ear vein of rabbit *B* and the disappearance of the active phosphatides from the plasma was followed. As seen in Table 1, about one half of the labelled phosphatide molecules disappeared in the course of 1¼ hours. To find what happened to the molecules which disappeared we killed the rabbit after 4 hours, extracted the phosphatides from the organs with ether-alcohol, determined the phosphatide phosphorus content of the extracts by the colorimetric method and their activity by making use of a Geiger counter. The results are seen in Table 1. Nearly one third of the labelled phosphatide molecules introduced into the plasma were after the lapse of four hours present in the liver; the muscles contained about 3 per cent, the other organs less. Though intestinal tract, bones and skin were not investigated, about 60 per cent of the labelled phosphatides introduced into the plasma could be recovered in the organs.

TABLE 1.

EXCHANGE OF LABELLED PHOSPHATIDES BETWEEN PLASMA AND ORGANS. (Active inorganic P is only present in negligible amount).

Time	Organ	Phosphatide P content in mgm.	Percentage labelled phosphatides introduced into the plasma present in the organ	Percentage organ phosphatides replaced by plasma phosphatides
0 min.	Plasma	3·08	100	—
26 ,,	,,	3·08	78·4	—
78 ,,	,,	3·08	47·6	—
116 ,,	,,	3·08	33·0	—
243 ,,	,,	3·08	20·9	—
	Corpuscles	2·48	0·94	2·35
	Liver	41·3	31·7	4·76
	Muscles	164·2	3·42	0·13
	Lungs	6·0	1·13	1·14
	Kidneys	5·82	0·96	1·00
	Heart	6·5	0·23	0·20
	Brain	13·4	0·06	0·27

TABLE 2.

FORMATION OF LABELLED PHOSPHATIDES.

Organ	Percentage of organ phosphatide synthesized in the course of 3¼ hours (obtained by comparing the specific activities of the inorg. P and phosphatide P of the organs)
Plasma	0·7
Liver	7·4
Muscles	1·2
Lungs	2·9
Kidneys	4·8
Heart	1·6
Brain	0·9
Spleen	2·4
Intestinal mucosa	4·1
Stomach	10·0

Radioactive phosphorus as an indicator has been used in numerous cases[1] to determine the relative rate and the place of formation of phosphatide molecules. The line of attack described above differs, however, entirely from that pursued in the references given above. We are following the exchange of phosphatide molecules between the plasma and the organs and not their formation from components. How these two entirely different magnitudes compare is seen in Tables 1 and 2. During the period in which 7 per cent of all the phosphatide molecules present in the liver are renewed by synthesis, 5 per cent of the phosphatide molecules of the liver are replaced by phosphatide molecules previously present in the plasma. The amount of newly synthesized phosphatides present, for example in the liver, was determined by comparing the specific activity of the liver phosphatide phosphorus with that of the liver inorganic phosphorus in experiments in which labelled sodium phosphate was injected into the vein of a rabbit drop by drop. The amount of labelled phosphatide synthesized from labelled inorganic phosphate and other components in the course of the exchange experiment can be entirely disregarded. Due to the intense interaction of the plasma phosphate with that of the organs, the amount of active inorganic phosphorus present in the plasma of rabbit *A* was only one third of that of the active phosphatide phosphorus at the end of the twenty-four hours. This ratio was further shifted in favour of the phosphatide phosphorus after injecting the plasma into rabbit *B*; 10 minutes later it was 1/50, and four hours later 1/150.

As seen in Tables 1 and 2, liver, in which a high phosphatide turnover takes place, exchanges easily its phosphatide molecules with those present in the plasma, while muscles, in which phosphatides are synthesized slowly, also exchange phosphatide molecules at a very slow rate. The kidneys show a different behaviour. There is a fast new-formation of phosphatides, while the rate at which the phosphatide molecules are carried into the plasma is slow.

Though the individual phosphatide molecules, as seen above, leave the plasma at a fairly fast rate, the speed with which they penetrate the walls of the capillaries and reach the lymph is much smaller than in the case of electrolytes. We introduced 1 c.c. plasma containing labelled sodium chloride into a rabbit; after the lapse of a few minutes we found the labelled sodium chloride to be diluted 590 times, showing that the labelled sodium is now distributed in 590 c.c. fluid. We carried out similar experiments with plasma containing labelled phosphatides and after the lapse of ten minutes found a dilution, in rabbits weighing 2·3–2·4 kgm. of 105–130. The phosphatides are, thus, distributed in a volume of

105–130 c.c. liquid, which is not very appreciably more than the total plasma volume. The latter amounts, in the case of a rabbit weighing 2·3 kgm., to about 90 c.c.

All data given in this note relate to those phosphatide molecules which are soluble in petrol ether. We found great differences in the turnover of the different types of phosphatides and this induced us to carry out similar experiments as described above with each of the different types.

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Preparation of Thyroxine from Casein treated with Iodine

IN a recent paper by Ludwig and Mutzenbecher[1] experiments are described in which treatment of casein with iodine under carefully defined conditions is stated to yield a physiologically active product from which thyroxine can be isolated.

In view of the existing knowledge of the chemistry of thyroxine, these results are so surprising that it appeared to us to be desirable to repeat the experiments. We have therefore carried out three preparations under the conditions laid down by the German workers and we have confirmed the findings of the latter in every respect.

The casein employed in our experiments was a commercial preparation (B.D.H. acetic-precipitated, soluble). Three separate lots of 100 gm. of this material gave, under Ludwig and Mutzenbecher's conditions of iodination, products containing 7·7, 7·7 and 8·7 per cent of iodine respectively; a physiological test on one of these products indicated an activity (as measured by the effect on the basal metabolic rate of the rat) of the order of 1/300 of that of thyroxine.

Hydrolysis of the iodinated casein preparations with barium hydroxide as described by the German workers led to iodine-rich fractions, containing 37–45 per cent iodine, solutions of which in 0·1 *N* sodium carbonate solution slowly deposited small amounts of a crystalline sodium salt; the latter could be converted in the usual manner into a compound indistinguishable in chemical properties from thyroxine and showing the full physiological activity of the latter; the chemical identification was completed by the catalytic deiodination of the product isolated to give a characteristic preparation of thyronine. The yields of crystalline thyroxine which we have isolated have been of the order of 100 mgm. from 100 gm. of iodinated casein.

There seems, therefore, to be no doubt as to the correctness of the results obtained by Ludwig and Mutzenbecher, and it becomes a matter of great interest to consider the possible mechanisms by which the formation of thyroxine in these experiments may be brought about.

The first point which seems to us to be significant is that the conditions employed by Ludwig and Mutzenbecher for the iodination of the casein, and which according to them must be closely observed, are not such as to bring about maximum substitution of iodine in the casein molecule but are rather such as to favour the oxidizing action of iodine. Now the hypothesis has been previously advanced by one of us that the biological synthesis of thyroxine may occur from tyrosine through the stage of diiodotyrosine, two molecules of which may undergo oxidative coupling with elimination of one side-chain; it has been supposed that an enzymic mechanism may exist in the thyroid gland by means of which this reaction could be brought about. In the experiments of Ludwig and Mutzenbecher the participation of oxidizing enzymes which might be present in the casein preparation could not be completely excluded owing to the conditions of the iodination (maintenance for about four hours at 37° and *p*H 8·5); we have found, however, that initial boiling of the casein in aqueous suspension does not affect the result, so that enzymic action cannot be involved.

There appear, therefore, to be two possibilities remaining: (1) iodine itself, under the conditions employed, may be able to effect the oxidative coupling of two molecules of diiodotyrosine which is postulated as a stage in the biogenesis of thyroxine; (2) casein may contain preformed thyronine as one of its constituent amino-acids and this may be iodinated to thyroxine.

The first of these explanations is favoured by Ludwig and Mutzenbecher; the difficulties in the way of its acceptance are (*a*) the inherent unlikelihood that iodine should bring about such a drastic oxidation and (*b*) the still greater improbability that a reaction of the type required should occur between two tyrosine residues within the protein molecule. On the other hand, although the presence of a small amount of thyronine in casein (and indeed in other tyrosine-containing proteins) might well have escaped detection hitherto, all attempts which have been made in the past to convert thyronine into thyroxine have failed.

We are at present engaged in experiments which it is hoped may throw further light on the chemical basis of the very interesting phenomena which the work of Ludwig and Mutzenbecher has revealed.

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The Cromer Forest Bed Implements

RESEARCHES I have carried out recently, by means of grants from the Royal Society, relating to the artefacts found in the basal layer of the Cromer Forest Bed, have shown that some six periods of flaking are recognizable on these specimens. I conclude, therefore, that the deposit containing them is composed, in part, of the wreckage of a land surface, or surfaces, on which the makers of the flint implements lived prior to the laying down of the Forest Bed. The various groups of artefacts from the base of this deposit differ not only in their patination and condition, but also, it seems, in their forms and flaking. One of the assemblages of specimens referable, apparently, to the earlier part of the Cromer Forest Bed, is that composed of the well-known ochreous-yellow implements, and flakes found upon the foreshore site at Cromer.

Since 1919, I have made periodical examinations of the large spreads of flint, exposed at low tide, along the shore from Sheringham to Mundesley, and it is beyond dispute that it is only at Cromer that the ochreous specimens are, or rather were, present in any quantity. They are exceedingly rare at Sheringham, West and East Runton, while to the south-east of Cromer, though stone beds are present upon the foreshore, no ochreous artefacts, so far as I have been able to observe, occur at these sites. These facts are of considerable significance when the question of the origin of the flaking of the ochreous specimens comes up for consideration. For example, they make it very difficult to believe that wave-action has been responsible for this flaking, as, apart from the lack of evidence that such action could produce the required effect, it is incredible that it would be confined, to all intents and purposes, to only one spot on the north-east coast of Norfolk. Moreover, the ochreous artefacts are not made from the flint which is being eroded from the chalk on the foreshore, but from another variety; while the everlessening number of the ochreous specimens on the Cromer site—a reduction brought about by their removal by archæologists and others—indicates that these flints are not being produced at the present time.

As is known, the ochreous artefacts generally exhibit a thick and ancient patination, while the flakes very often show flat striking platforms, prominent cones and bulbs of percussion and the usual characteristics of human workmanship.

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Reduction of the Ctenidia in the Lamellibranchia

THE ctenidia of a typical lamellibranch are each composed of two demibranchs arranged one on each side of the ctenidial axis. In three families, however, the Lucinidæ, the Montacutidæ and the Teredinidæ, the ctenidium is composed of one demibranch only. A list of such lamellibranchs found in British waters is given by Atkins[1], type *G*. It is reproduced below.

Lucinidæ.
Myrtea (*Lucina*) *spinifera*.
Phacoides (*Lucina*) *borealis*.
Montacutidæ.
Montacuta ferruginosa.
Montacuta substriata.
Myella (*Montacuta*) *bidentata*
Teredinidæ.
Teredo norvegica.
Teredo navalis.
Teredo megotara.
**Xylophaga dorsalis*.

A similar condition obtains in the American genus *Bankia*, as shown by Sigerfoos[2] who examined *B.* (*Xylotrya*) *gouldi*.

It has generally been assumed, on little definite evidence, that in all these cases it is the outer demibranch which has been lost[1,2,3,4]. The question can only be definitely decided by determining the positions of the afferent and efferent branchial veins. The afferent vein invariably runs in the ctenidial axis. It receives blood from the kidney and passes it down the descending lamellæ of the ctenidium. The typical lamellibranch possesses two pairs of efferent veins which run along the dorsal margins of the ascending lamellæ of each ctenidium. They convey blood from the ctenidia to the auricles. This normal arrangement is indicated in *A*.

* Evidence has been produced which justifies placing *Xylophaga* in the Teredinidæ. This will be published elsewhere in due course.

Where one demibranch has been lost, the relative positions of the afferent and efferent branchial veins remain unchanged (*B*, *C*). By the examination of serial sections it is possible to trace the connexion between the afferent vein and the kidney, or between the efferent vein and the auricle, and thus (by identifying the veins) to determine the position of the ctenidial axis.

Menegaux[3] discusses the position of the afferent and efferent veins in *Lucina*, and his description leaves no doubt that in the Lucinidæ the single demibranch is the *outer* one (*B*).

DIAGRAMMATIC TRANSVERSE SECTIONS TO SHOW REDUCTION OF THE CTENIDIA IN CERTAIN LAMELLIBRANCHS. A, TYPICAL LAMELLIBRANCH. B, LUCINIDÆ AND TEREDINIDÆ. C, MONTACUTIDÆ.
The afferent branchial vein at the ctenidial axis is figured black, and the efferent branchial veins at the dorsal borders of the ascending lamellæ are figured white.

In the Montacutidæ, I have been able to examine one species only, *Montacuta ferruginosa*, in which it is clear that it is the *inner* demibranch which is retained (*C*). This is in accordance with the views of Miss M. L. Popham, who has sectioned all the species of the Montacutidæ found in British waters.

Examination of the illustrations of *Teredo* and *Bankia* given by Ridewood[4] and Sigerfoos[2] respectively make it abundantly clear that in these genera it is the *outer* demibranch which is retained. My own investigations on *Xylophaga dorsalis* establish that a similar condition obtains in this species.

In the Lucinidæ and Teredinidæ, therefore, the ctenidium is composed of the *outer* demibranch only, whereas in the Montacutidæ the single demibranch is the *inner* one.

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Cranidial Muscle Scars of '*Illænus*' *proles* var. *shelvensis* Whittard

FROM the core of the Walsall boring[1] which was put down in 1935, Dr. and Mrs. A. J. Butler collected a large number of Silurian fossils. Among those from the Purple Shales of the Upper Llandovery there are internal casts of two trilobite middle-shields referable respectively to *Phacops* (*Portlockia*) *elegans* Sars and Boeck, obtained at a depth of 1,050–1,055 feet, and to '*Illænus*' *proles* var. *shelvensis* Whittard, from 982–987 feet down. The illænid, as shown in the accompanying figure, though rather larger than the individuals upon which Prof. Whittard founded the variety[2], differs from these only in the remarkable preservation of the impressions of what seem to be

muscular platforms. The pair of these which occur at the front of the glabella are expanded anteriorly, and are covered with small depressions like those occurring at points of muscular attachment in modern Crustacea. About 0·6 mm. behind these well-marked muscular platforms under the posterior part of the glabella we find another pair that are poorly defined with small raised areas sometimes isolated, irregularly arranged, and not so high as those in front.

INTERNAL CAST OF MIDDLE-SHIELD OF "*Illænus*" *proles* VAR. *shelvensis* WHITTARD, SHOWING IMPRESSIONS OF PAIRED MUSCLE-PLATFORMS UNDER FRONT PART OF GLABELLA, WITH A PAIR OF FAINTER AND LESS REGULAR MUSCULAR AREAS BEHIND. ×1¾.
Birmingham University Geological Museum, Figured Collection T. 215.

In cranidia areas of muscular insertion have been previously described by von Volborth and Prof. Öpik. In his *Illænus crassicauda* var. *dalmanni*, von Volborth[3] found four paired areas under the glabella —the illustration is copied by Salter[4]—and clearly distinguished these from a pair of elongate oval depressions in the axial furrows. None of von Volborth's scars, we note, is relatively as large as the front pair in '*I.*' *proles* var. *shelvensis*. Under the frontal lobe of the glabella of several species of *Chasmops* Öpik[5] has discovered small elevations in two rows converging in front and behind, which he regards as points of attachment for the muscles which served to dilate the œsophagus.

In explaining the novel musculature of '*Illænus*' *proles* var. *shelvensis*, the easiest supposition is that it may have arisen through fusion of muscle impressions like those seen in *I. crassicauda* var. *dalmanni*, probably three pairs going to the making of the large anterior muscle scars of the Walsall form. This development may have been connected with change in feeding habits, for example, evolution of a sucking mouth, as it is unlikely that an enlarged pair of mandibular appendages ever appeared in the Illænidæ.

The genotype of Illænus is *I. crassicauda* (Wahlenberg). Von Volborth's variety certainly seems to come close to this. It would, therefore, be justifiable at once to separate '*I.*' *proles* var. *shelvensis* as the representative of a new genus. It has been thought better, however, to delay placing the Shelve and Walsall specimens in a new systematic position, since re-examination of collections of illænids may in the near future give additional information about the condition of cranidial muscle platforms and the possible value of these features in taxonomy.

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'Auto-parasitism' by *Nemeritis canescens* (Grav.) (Ichneumonidæ)

THERE appears to be no published record of oviposition by an insect in the body of another of its own species. This interesting phenomenon, however, occurs in *Nemeritis canescens* (Grav.) (Hymenoptera: Ichneumonidæ), a parasite of the Mediterranean flour moth (*Ephestia kühniella* Zeller) in certain circumstances.

Nemeritis canescens breeds parthenogenetically and is ready to oviposit within half an hour after its emergence from the pupa. In a jar containing fully grown host larvæ, the parasites which develop from them do not emerge simultaneously. Those that emerge first try to oviposit in those that will emerge in a day or two. The parasite succeeds in laying one or more eggs if its ovipositor pierces the soft ventral side of the abdomen of the imprisoned parasite in the silken cocoon. The egg hatches into a larva which undergoes a part of its development in the abdomen of its host, which, nevertheless, develops into an imago and may live for some days afterwards.

Experiments corroborated the above observations. Two parasites were released for six hours in a small jar containing about forty advanced parasite pupæ from which the imagines were expected to emerge in a day or two. As each imago emerged, it was at once transferred to a tube and fed on sucrose solution until it died. Twenty-five such parasites were fed in this way, and inside the abdomen of two of them partly developed parasitic larvæ were found. They were both dead.

In cultures where 80–100 parasites are reared in a jar the percentage is found to be much higher. For batches of 10–20 parasites emerge at intervals of 12–24 hours, and when two batches of about forty parasites have emerged the chance of some of these successfully ovipositing in those that are yet to emerge is high.

Another interesting fact observed was that in Ephestia larvæ, where superparasitism by *Nemeritis* is a common occurrence, all parasitic larvæ in one host, except one, die in the first instar. Nevertheless, in the abdomen of an adult parasite that was dissected two larvæ were found, one well advanced in the third instar and the other in the second instar.

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Pure Ethyl Alcohol for Absorption Spectrophotometry

ETHYL alcohol which has been dehydrated by an azeotropic process is liable to contain traces of absorbent impurities, for example, benzene[1], which make it more difficult to purify for absorption spectrophotometry. Alcohol known to have been produced by one of the above methods was subjected to the following processes:

(1) To each litre of alcohol 20 c.c. of water and 4 c.c. of sulphuric acid were added and the mixture refluxed for 2–3 hours, after which it was distilled, rejecting the first and last 10 per cent.

(2) 1·5 gm. of silver nitrate was dissolved in the minimum quantity of water and added to the alcohol in a tall vessel. To this was then added drop by drop and without shaking a solution of 3 gm. potassium hydroxide in 10–15 c.c. alcohol. This allows the silver oxide to precipitate in a finely divided form, and the vessel is left until all the precipitate has settled. The silver oxide is either filtered off or the liquid decanted and distilled, rejecting the first and last fractions as before[2].

(3) To remove the water, the alcohol was refluxed with calcium oxide in an atmosphere of nitrogen, the oxide itself having been prepared in an atmosphere of nitrogen.

(4) The purification was completed by distilling the product from (3) in an atmosphere of nitrogen.

Of the various methods which have been suggested for the purification of ethyl alcohol, the above sequence was found to be the most satisfactory, each step extending the transmission farther into the ultra-violet, the absorption curve for the final product being almost identical with that found by Harris[3] and superior to that found by Leighton, Crary, and Schipp[4] and Bielecki and Henri[5]. A final distillation from aluminium amalgam did not increase the transmission in the ultra-violet.

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[1] Fritzweiler and Dietrich, *Z. Spiritusind*, **53**, 27 (1930).
[2] Dunlop, *J. Amer. Chem. Soc.*, **28**, 395 (1906).
[3] Harris, *J. Amer. Chem. Soc.*, **55**, 1940 (1933).
[4] Leighton, Crary and Schipp, *J. Amer. Chem. Soc.*, **53**, 3017 (1931).
[5] Bielecki and Henri, *Ber.*, **45**, 2819 (1912).

Points from Foregoing Letters

N. Bohr, R. Peierls and G. Placzek discuss the typical difference between nuclear reactions in the regions of discrete and continuous level distributions of the compound nucleus. The argument developed is used to clear up an apparent difficulty as regards the order of magnitude of the cross-sections of heavy nuclei for the photo-effect with ejection of neutrons.

La. Goldstein, A. Rogozinski and R. J. Walen have studied the diffusion of fast neutrons by uranium nuclei and the possibility of showing the emission of neutrons when this nucleus explodes. The sum of the cross-sections for elastic and inelastic scattering and for fission found implies that a chain reaction of fission, if such chain is possible, may be observed in a smaller mass than was hitherto thought necessary.

D. F. Gibbs and G. P. Thomson describe experiments with an intermittent source which show that the majority of the neutrons produced in the fission of uranium appear with a delay of less than 10^{-3} sec.

J. B. R. Rajam, P. C. Capron and M. de Hemptinne describe a method of determining the beta upper energy limits of radio-elements. The ordinary absorption data are used to construct the Fermi and Konopinski-Uhlenbeck curves, from which the upper limit is deduced by extrapolation. Results are given for radio-rhodium and radio-silver.

J. Aharoni suggests a new method for determining e/m for electrons of about a million volts energy. It is particularly applicable to electrons and positrons forming the continuous spectrum from radioactive bodies.

The exchange of phosphatide molecules between plasma and organs is compared by L. Hahn and G. Hevesy with the turnover of phosphatides in the latter.

C. R. Harington and R. V. Pitt Rivers report experiments confirming the recent observation of Ludwig and Mutzenbecher that treatment of casein with iodine under carefully controlled conditions yields a product which has physiological activity similar to that of thyroglobulin and from which thyroxine can be isolated. The mechanism of the formation of thyroxine under these conditions is discussed.

Some six periods of flaking have been recognized by J. Reid Moir upon the artefacts from the basal layer of the Cromer Forest Bed. One of the assemblages of specimens referred to is composed of the well-known yellow implements and flakes found upon the foreshore site at Cromer. The conditions existing at this site make it improbable that these specimens have been flaked by wave action.

R. D. Purchon states that in three families of Lamellibranchia the ctenidia are reduced to one demibranch on each side. This has always been assumed to be the inner one. By determining the position of the afferent and efferent veins, the former always running through the axis, it has been shown that in the Lucinidæ and Teredinidæ the inner demibranch has been lost; only in the Montacutidæ has the outer one been lost.

A. Lamont records an unexpected reduction in the number of cranidial muscle-scars in '*Illænus*' *proles* var. *shelvensis*, and points to the possible use of these features in the systematic subdivision of a difficult family.

An interesting phenomenon of one insect ovipositing in the body of another of its own species was observed in *Nemeritis canescens* (Grav.), by E. S. Narayanan. In Ephestia larvæ superparasitism by Nemeritis is a common occurrence, but all except one die in the first instar. In the abdomen of an adult parasite two larvæ were found, one in the third instar and the other in the second instar.

RESEARCH ITEMS

Artificial Parthenogenesis and Chromosome Constitution

AN extensive study of the effects of artificial parthenogenesis upon the chromosome constitution of the cells resulting from the subsequent cleavages in the eggs of the frog *Rana nigromaculata* is reported by T. Kawamura (*J. Sci. Hirosima Univ.*, Series B, 1939). In most instances the successive cleavages occurred at the normal times, but in about 18 per cent they were delayed. The histories of 1,073 eggs were followed and in 413 that lived longer than seven days the chromosome number was determined; 49 per cent of these were haploid, 21 per cent were diploid, 23 per cent were triploid. The remainder were divided among tetraploid, hexaploid, hyperploid, haploid-diploid, haploid-triploid, haploid-pentaploid and triploid-hexaploid. In each instance an attempt is made to explain how the particular condition originated. The most viable type is the diploid. Some of the external characters of the parthenogenetic larvæ are described. The paper is provided with numerous tables and illustrations of the various chromosome conditions.

Properties of Renin

O. M. Helmer and I. H. Page (*J. Biol. Chem.*, 127, 757; 1939) describe a method for purification of renin, a pressor substance from the renal cortex first described and so named by Tigerstedt and Bergman in 1898. The purest preparations raised arterial blood pressure 30 mm. mercury in dogs when injected in amounts representing 0·027 mgm. of nitrogen per kilo of body weight. In cats it was three times as active; 0·009 mgm. of nitrogen-containing extract produced the same rise. Colour tests for guanidin groups and for pentose were found to be especially strong in renin solutions, while those for adrenin were negative. Crystalline precipitates were formed on addition of flavianic acid or picric acid to hydrolysates of renin. The pressor action of renin in cats and dogs was not abolished by ergotamine or potentiated by cocaine, as is adrenin. Cats anæsthetized with pentobarbital supply suitable preparations for assay purposes.

Origin of Dahlia Varieties

A PAPER by A. J. Cobb (*J. Roy. Hort. Soc.*, **64**, Pt. 5, May 1939) gives a clear description of the origins of several types of garden dahlias. Vicente Cervantes, director of the Mexico Botanical Gardens, sent seeds and roots of *Dahlia pinnata* to Madrid, for the Abbé Cavanilles, in 1785, though the plant had been known in Mexico as early as 1575. *D. coccinea* and *D. rosea* were also described by Cavanilles in 1791. These three species were the parents of all the garden and show varieties until the appearance of the cactus dahlia. This last type was introduced by Henry Cannell in 1879, and was named *D. Juarezii*. Still another form, *D. Merckii*, was used as a parent in 1903, and thereby the forms with dark central disks and light ray florets were brought within horticultural practice. The dwarf 'Coltness Gems' are selections from progeny of this stock crossed with other garden varieties. The paper under review also gives detailed accounts of the practical cultivation of dahlias.

Triploid Red Alga

Kathleen M. Drew (*Ann. Bot.*, N.S., **3**, 347–368; 1939) has studied populations of *Plumaria elegans*. Plants bearing sexual organs have 31 chromosomes and plants bearing tetrasporangia have 62 chromosomes. A cystocarp results from fertilization, and reduction division takes place in the tetrasporangium. In addition, several plants bearing parasporangia and an occasional tetrasporangium had 93 chromosomes. These triploids form triploid paraspores. The development of the parasporangia is shown to be distinct from that of tetrasporangia, and the relationship between the triploid plants and the diplobiontic life-history of the species is as yet unknown.

Fruit Flies of China

WE have received a copy of *Sinensia* (Contributions from the National Institute of Zoology and Botany, Academia Sinica, vol. 8, No. 2, April 1937). This journal is a bi-monthly publication and each volume comprises six parts with a total of 500–800 pages. It is to be obtained from the director of the Institute, 68 Ching Hsien Street, Nanking, price 6 dollars (Chinese) for foreign subscribers. The present issue is largely occupied by an important paper on the Trypetidæ or fruit flies of China, by Y. Zia (pp. 103–226). Altogether 101 species are recognized, including one genus and 16 species that are described as new. This memoir is of special interest to workers on oriental Diptera and is a carefully executed and well-illustrated contribution. The remainder of the present issue of the journal is occupied by a paper entitled "Additional Fungi from China", (6), by S. C. Teng and S. H. Ou (pp. 227–297).

Fruit Breeding in the U.S.A.

THE *American Fruit Grower* of March contains articles on the breeding of new varieties of fruits. M. A. Blake summarizes some of the results of the breeding programme started at the New Jersey experiment station in 1914 to determine facts about the inheritance of characters in the peach and to develop varieties of higher quality than those existing at the time. It takes at least five or six years to make a cross and obtain the first good crop of fruit. The following facts have been established during the past twenty-five years. When a variety with pure white-fleshed fruit was crossed with another white-fleshed variety, the progeny all gave pure white-fleshed fruit. Crosses between two heterozygous white-fleshed varieties gave progeny 75 per cent of which gave white-fleshed and 25 per cent yellow-fleshed fruit. A variety with pure white-fleshed fruit crossed with a yellow-fleshed variety gave an all white F_1 generation. Red flesh around the pit was found to be dominant over absence of red, whilst heavy pubescence was dominant over light or absence of pubescence. Small size of fruit was dominant over large. J. C. Miller contributes an article on strawberry breeding at the Louisiana experiment station. The variety Klondike accounts for 95 per cent of the total plantings in this area. Breeding experiments aim at raising varieties sweeter than Klondike, but with the same shipping qualities and resistant to leaf

spot (*Mycosphærella fragariæ*) and scorch (*Diplocarpon earliana*). Crosses have been made between varieties which show any resistance to these diseases. The resulting fruit is fermented to free the seeds, which are then dried and cold-stored until December. They are germinated in a greenhouse and the best plants planted outdoors in May; 20 to 40 of the 250 to 600 plants produced by each seedling are transplanted and sprayed every ten days with spore suspensions of the leaf spot and scorch diseases. All except 2–5 per cent of the seedlings are eliminated in the first year, the remainder being studied further for yield and quality.

Lime Sulphur Injury

LIME sulphur has been used as a fungicide for more than a hundred years and is still the most effective agent known for the control of apple scab. In certain conditions, however, it causes considerable damage to foliage and fruit. Scorching of the leaves and shedding of fruit are the most obvious symptoms, but recent work (summarized by Norman F. Childers, *American Fruit Grower*, April) has shown that less obvious but equally serious damage may result. Trunk growth of trees sprayed with lime sulphur may be much reduced, and reductions in the leaf growth of apples and cherries have been demonstrated. Heinicke and Hoffmann have recently shown that spraying may seriously reduce the rate of photosynthesis, especially at high temperatures. These reductions persisted for seven days or longer, with no apparent external injury to the leaves. Preparations of elementary sulphur are generally much less damaging in this respect, but on the other hand are less effective against bad attacks of scab.

The Smut Fungi

PROGRESS of knowledge about the life-cycles of the smut fungi has gradually revealed a bewildering though fascinating variety, which Miss Kathleen Sampson described in her presidential address to the British Mycological Society (*Trans. Brit. Mycol. Soc.*, **23**, No. 1, 1–23, May 1939). The Ustilaginales show a general similarity of life-history to the larger Hymenomycetes, but each species appears to have its own characteristics. Fusions of nuclei appear at different stages, but are often associated with the young chlamydospore. Meiosis often follows close after fertilization. Heterothallism is common but is occasionally a complex organization, with four factors instead of two. Smut fungi appear readily to adopt a saprophytic mode of life, a fact which should not be forgotten when economic measures of control are being planned. The plus and minus strains of simple heterothallic forms can often be separated by growth upon selective media. Genetic implications of heterothallism are also discussed, whilst the frequency of specific hybrids and the ever-increasing number of physiological forms raise considerable anxiety as to the validity of species concepts. An examination of the available evidence leads Miss Sampson to the conclusion that the parasitic mycelium of smut fungi has two types of nuclei associated in a loose partnership which is more typical of the Hymenomycetes than the Uredinales. The paper provides a wealth of information for the teacher in mycology, and is an authoritative stocktaking of extant knowledge about a very difficult group of fungi.

A Fungus upon the Liverwort *Riccia Himalayensis*

LIVERWORTS are occasionally attacked by fungi. The Jungermanniales provide the most numerous hosts but an increasing number of the Marchantiales are now known to be subject to fungal attack. K. S. Srinivasan has recently described a further parasite on *Riccia himalayensis*, a liverwort growing in Madras (*Trans. Brit. Mycol. Soc.*, **23**, No. 1, 55–62, May 1939). The fungus is *Phærosphaerella Riccia*, and it appears to be limited to the gametophyte stage of its host. Spermogonia and perithecia are formed, with numerous asci, but the oogonia are non-functional and rapidly disintegrate. The spermogonia liberate spermatia which, however, are of no use by themselves. Asci are produced from ordinary vegetative hyphæ. Sclerotia are formed in the liverwort thallus, and serve to perpetuate the fungus from year to year.

Movement of Water in the Soil

IN his presidential address to the Royal Meteorological Society, B. A. Keen gave an account of how a theory of the movement of water in the soil that has long been generally accepted, and which provides a simple and plausible explanation of certain traditional cultivation practices such as rolling, harrowing and hoeing, has had to be abandoned in recent years and to be replaced by a new theory developed and experimentally verified mainly by Haines and Schofield. (*Quart. J. Roy. Meteor. Soc.*, April 1939.) The old theory is the capillary theory of soil water movement, according to which the rain that percolates to some depth into the soil forms a reservoir that can be drawn on by plants in drought, the water ascending by capillary tubes, built up from the spaces between the soil particles, from saturated levels many feet below the surface to supply the roots of the plants at higher levels. According to this theory, harrowing and hoeing conserve moisture by destroying the top few inches of the capillary tubes and so checking evaporation from the surface, while rolling crops in spring reverses the process by diminishing the space between soil particles near the surface and so allowing the capillary tubes to bring water to the upper layers of the soil. It was found at Rothamsted from observations on the water level in cylinders closed at the bottom and filled with various soils, the top being kept free of weeds, that capillary rise actually does not exceed 3 or 4 feet even in such a drought as that of 1921. Haines showed, moreover, that the pore space in soil is essentially cellular, not capillary, and that with both increasing and decreasing moisture content the movement of water takes place through sudden changes corresponding with the abrupt emptying and filling of the cells. Schofield investigated the marked hysteresis in moisture content according as the soil is being moistened or dried. Under the new theory, it may be noted, the value of cultivation lies in the encouragement of soil crumb formation, while its control of soil moisture is confined to the removal of weeds that are competing for moisture and nutriment.

The Central Core of the Earth

Gutenberg and Richter, in their fourth paper "on seismic waves" (*Gerlands Beiträge zur Geophysik*, **54**, 94–136; 1939) revise the travel times and velocities of such waves as have been given previously by them, using for the purpose observational data from deep focus earthquakes. The new tables contain

calculated travel times for zero focal depth for the important phases of earthquake waves, and a re-interpretation of the observations of the waves *P'* and *SKS*. In this connexion the authors give a diagram showing the passage of longitudinal waves through the earth's core and exhibiting the refraction which, from their observations, appears to amount almost to total reflection for a wave approaching an inner core. A table is also given of the velocities of seismic waves and the calculated elastic constants of the materials through which the waves pass, all given as functions of the depth within the earth.

Preparation of *l*-Tartaric Acid

THE resolution of the mirror-image hemihedral crystals of sodium ammonium tartrate by Pasteur is the classical example of the resolution of racemic tartaric acid. Later, Pasteur observed that the mould *Penicillium glaucum* would consume ammonium *d*-tartrate from a solution of the racemate, thus effecting a preparation of ammonium *l*-tartrate. The third method of Pasteur was by salt formation with an optically active base, cinchonine. The latter was the only method of practical significance and was the usual procedure for the preparation of *l*-tartaric acid. The procedure is tedious and the yield poor. W. T. Haskins and C. S. Hudson (*J. Amer. Chem. Soc.*, **61**, 1266; 1939) have now described an improved method of obtaining *l*-tartaric acid which gives an overall yield of more than 90 per cent. It depends on the resolution of racemic acid with 2[*d*-gluco-*d*-gulo-hexahydroxyl]-benzimidazole. In the same paper a new method of preparation of benzimidazoles substituted in the [2] position with sugar residues is described which is based on the reaction of aldonic acids or lactones with *o*-phenylenediamine, and the properties of a number of these substituted benzimidazoles are described. In the resolution, the racemic acid and base were dissolved in hot water, alcohol was added, and crystallization induced by scratching. The crystalline acid-*l*-tartrate salt which separated was washed with alcohol and could be recrystallized with negligible loss. The *l*-tartaric acid was obtained by precipitating the base with ammonia, precipitating the acid in the filtrate as the lead salt, and decomposing this with hydrogen sulphide.

Electrical Interference

WE have received from the British Thomson-Houston Company, Ltd., a pamphlet containing two papers by T. H. Kinman of its research laboratory entitled "Radio Interference Measurements" and "Electrical Interference in Flying" respectively. Considerable progress has now been made in producing 'radio-interference-free' electrical appliances, and in many cases troublesome 'interference' with radio can be very satisfactorily suppressed. The British Standards Institution now issues to manufacturers a special mark which they can stamp on their radio apparatus when it satisfies the limits of the disturbance tolerated in the B.S.I. specification. Measurements are at present mainly limited to the medium and long-wave broadcast frequencies between 1,500 and 200 kilocycles. In aeroplanes which have radio communication with the earth, great pains are taken to prevent interference produced by the ignition apparatus on board by waves of almost any frequency. In some aeroplanes, particularly those owned privately, where no devices for suppression are employed, the interference they produce with the radio apparatus of other aircraft or of television sets on the ground is very serious. If this aeroplane move parallel to other aeroplanes, it may cause danger as well as annoyance to them by preventing them from landing during fogs, etc. The low audible frequency which is heard after rectification in the receiver is characteristic of spark frequency and can be used to distinguish whether it comes from a magneto or a motor.

Catalogue of Double Star Orbits

A CATALOGUE of orbits for visual binaries is published from the Lund Observatory, Sweden, by B. Ekenberg. It supplements a preceding catalogue by Luplau Janssen, Fjeltofte and Lauritzen, who gave a list of all orbits computed up to 1926. Other catalogues by Finsen and by Baize have been published, but these usually select the best derived orbit for each pair. The catalogues from Lund give all computed orbits for any one star, and such a list will be found very useful by double-star observers and computers. The two Lund compilations contain 1051 orbits relating to some 197 systems. (The number of other pairs in which orbital motion, often very slow, is observable exceeds 1,500.) In addition, there are more than fifty orbits received after the printing of the Catalogue and given in an appendix. Among the interesting re-computed orbits included in the present list are: (1) γ Andromedæ BC with a period of from 55 to 56 years and a high eccentricity of 0·83 or 0·92 according to two separate computers. The present apparent separation of the component stars is about 0·43″. (2) α Centauri with a period of 80 years and eccentricity of orbit 0·52. (3) The spectroscopic binary *Aa*, comprising the brighter star of the well-known binary, ζ Ursæ Majoris (Mizar), with a period of 20·5305 days and eccentricity of orbit 0·53. The observations giving this orbit were made at Mt. Wilson with the 20-foot interferometer attached to the 100-inch reflector, the observed separation of the components being of the order 0·01″.

A Simple Wedge-Photometer

H. W. NEWTON has recently published a paper describing a simple wedge-photometer for observing bright chromospheric eruptions with a spectro-helioscope (*Mon. Not. Roy. Astro. Soc.*, **99**, 5, March 1939). Within recent times there has been established a relationship between bright chromospheric eruptions and sudden ionic disturbances, and it has become necessary to obtain further data concerning the intensity of the solar eruptions. The simple wedge-photometer, described in the paper, is intended to make rapid measurements of the intensities of bright chromospheric eruptions observed with a spectro-helioscope. A secondary line shifter half the height of the primary one enables a comparison of the peak intensity of a flocculus to be made directly with the adjacent continuous spectrum. Each instrument requires certain corrections on account of its finite resolving power and also for scattered light. Uncorrected observations of bright eruptions will provide the order of magnitude and the time-intensity curve for any particular eruption. The instrument will fulfil its purpose—to make rapid observations in conditions where the phenomena under investigation are varying very quickly, and where speed rather than great accuracy is required.

RECENT EXPERIMENTAL RESULTS IN NUCLEAR ISOMERISM

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THE hypothesis that two atomic nuclei indistinguishable in respect of atomic and mass number could nevertheless have different radioactive properties (the hypothesis of nuclear isomerism) was put forward for the first time by Soddy[1] in 1917. In 1921 uranium Z was discovered by Hahn[2]; by studying the chemical and radioactive properties of this element, Hahn deduced that uranium Z and uranium X_2 are isomeric nuclei. The problem of uranium Z has been taken up recently by Feather and Bretscher (*Proc. Roy. Soc.*, **165**, 542; 1938). It should be noted that, for many years, uranium Z and uranium X_2 were the only known example of an isomeric pair.

After the discovery of artificial radioactivity, the study of isomerism received considerable impetus on account of the experimental material assembled in the course of research on artificial radio-elements. The first *certain* example of an isomeric pair to which it has been possible to attribute a mass number ($A = 80$) in the domain of the artificial radio-elements was furnished[3] by the study of the radioactivity produced in bromine by neutrons (slow and fast) and by γ-rays of great energy.

Then, as the experimental material on artificial radio-elements has increased, the number of pairs of nuclei which are undoubtedly isomeric has grown to such an extent that it is not possible to quote here all the investigations which have been published on the question. More than thirty such pairs are known and there is no doubt that the number still unknown is much greater. We can say, now, *that nuclear isomerism is by no means an exceptional phenomenon.*

It is natural to think that the physical difference between two isomeric nuclei is connected with two states of different excitation of the same nucleus (let us say ground state and first excited state). But in this case, how could the upper state be metastable, that is, how could it live for any length of time (greater than one day, in some cases)? By what mechanism would it be preserved from destruction in a very short time by the emission of an electromagnetic radiation? Weizsäcker has answered this question[4].

According to Weizsäcker's *hypothesis*, nuclear isomerism may be explained by assuming that *the lowest excited state of the nucleus has an angular momentum differing by several units from that of the ground state.* Selection rules may then be invoked to weaken considerably the probability per unit of time of the transition from the upper to the ground state of the nucleus. Of course, experiments which make it possible to test the truth of Weizsäcker's hypothesis are of great interest.

One of the most important points is the study of the γ-radiation eventually emitted in the transition from one isomeric state to another: I say "eventually emitted" because, the nucleus being radioactive, the upper state corresponding to one of the isomeric forms may be destroyed by an ordinary β transition. The γ-ray – β-ray branching ratio will depend on the relative life-times for the two modes of decay. The first researches made to observe this γ-radiation failed. But it should be noted[5] that the considerable difficulty in detecting this radiation might be due to the fact that transitions between isomeric nuclei can be strongly converted: in this case electrons of small energy would be emitted and not γ-rays.

The very complete theory of the internal conversion of radiations emitted in the transitions between isomeric states[6], given by Hebb and Uhlenbeck, Dancoff and Morrison, has shown that these radiations must have internal conversion coefficients of approximately 1. Since these calculations are based on Weizsäcker's hypothesis, it can be concluded that *experiments which prove that the conversion coefficient in question is very high would indicate, to a certain extent, that Weizsäcker's hypothesis is correct.*

Indeed, in the case of the isomerism of radio-rhodium, Pontecorvo[7] has observed a radiation of low-energy electrons, which he interpreted as an electron line emitted in the transition from the metastable state to the ground state of the nucleus.*

At the present time, after a number of recent experiments, *there is no longer any doubt as to the fact that these transitions are generally strongly converted.* In particular, in the cases of isomeric nuclei of radio-bromine[8] and of element 43 *, strong lines of conversion electrons have been photographed in the Wilson chamber or in the magnetic spectrograph. Of course, the internal conversion is accompanied by emission of X-rays: as a rule, the analysis of these rays is an invaluable test in the interpretation of these phenomena[9,10].

It is interesting to find possible genetic relations between isomeric states of the same nucleus (β-radioactive): in this direction an extremely brilliant method has been described by Segré, Halford and Seaborg[11], who have succeeded in *separating*, one from the other, the two isomeric forms of radio-bromine. The principle of their method is as follows. Suppose the element, of which the isomeric states are being studied, can give compounds suitable for the application of the Szilard-Chalmers method of concentration. When the isomer in the upper state decays to the lower state, there is a γ-ray emission: corresponding recoil may be sufficient to knock the decayed atom out of the compound. The daughter activity can then be separated, as in the Szilard-Chalmers method.

* Note added in proof. A similar conclusion was independently obtained by Roussinow and Yusephovitch [*C. R. Acad. Sci. U.R.S.S.*, **20**, 9 (1938)] who observed a soft electron radiation in the case of isomeric forms of radio-bromine.

This method, which has been successfully applied in several cases[12], can then be used (*a*) to separate known isomers in some cases; (*b*) to discover the existence of isomeric pairs, still unknown, in the study of artificial radioactivity.

Moreover, it has given a striking new proof that the transitions between isomeric states are strongly converted: in effect, the recoil due to the γ-emission is not sufficient to knock the decayed atom out of the compound, while the recoil of a conversion electron *can* be sufficient.

So far we have discussed radioactive isomers: the isomerism, in this case, implies a difference in the life-times of the isomers. It has been noticed by Pontecorvo[6] that β-stable nuclei with a metastable excited state ought not to be very rare and should be revealed by the study of the radiation emitted by this metastable state. These nuclei are interesting for the understanding of nuclear isomerism, because the radiation corresponding to the transition from one isomeric state to the other is not troubled by the presence of β- or γ-rays. It should be possible to obtain a β-stable nucleus in a metastable state, after a nuclear transmutation or a radioactive disintegration.

Dodé and Pontecorvo[13], by bombardment of cadmium with fast neutrons, have obtained an activity (T = 50 min.) which chemical proofs have shown to be due to an isotope of cadmium. On the other hand, there is no question of a reaction of simple neutron capture or of an $n,2n$ reaction. They interpreted the soft radiation emitted by cadmium (50 min.) as proceeding from a metastable state of an isotope of cadmium; the reaction of excitation without capture by fast neutrons (reaction n,n), having a considerable cross-section (some 10^{-24} cm.^{2}), it is not impossible, indeed, that part of the nuclei so excited might fall into a metastable state.

Segré and Seaborg[9] have observed a metastable state of element 43, decaying (only a line spectrum of electrons) with a 6-hour period into the ground state, which is stable or perhaps radioactive with a long life: the 6-hour activity is daughter of a β-radioactive molybdenum.

A very interesting case has been observed and studied thoroughly by Goldhaber, Szilard and Hill[14]. They have obtained by the n,n reaction already quoted, a metastable state (^{115}In*) of ^{115}In, decaying with a period of 4·1 hours; moreover, the same state can be obtained after the disintegration of a radio-cadmium (T = 2·5 days). The radiation emitted by ^{115}In* has not yet been sufficiently studied; its properties are of the greatest interest both for the understanding of the nuclear isomerism and for that of isobaric pairs. In effect, ^{115}In and ^{115}Sn are one of the rare cases of stable neighbouring isobaric nuclei: ^{115}In* might then decay into ^{115}Sn (β-emission) or into ^{115}In, or into both together.

The same metastable state of ^{115}In has been obtained also by irradiating indium with 5·8 Mev. protons (reaction p,p), by Barnes and Aradine[15]. Nevertheless, it is not yet clear whether the mechanism of nuclear excitation is that discussed by Weisskopf, that is, excitation by the action of the electric field of the proton[16].

In all these cases and in others studied more recently[17], the metastable states of stable isotopes are obtained from *nuclear transmutations*.

Lazard and Pontecorvo[18] have tried a new method, by which *it would be impossible to transmute the nucleus* and, consequently, to obtain artificial radio-elements, the presence of which may interfere with the investigation.

This method consists of irradiating the target with a continuous spectrum of X-rays, the energy of which is less than the dissociation energy of the nuclei. Suppose the radiated nuclei have a metastable state; the X-rays may excite higher levels of the nuclei; a part of the nuclei thus excited can fall into the metastable state, and it is the radiation from this state which can be observed. The maximum energy of the continuous spectrum utilized was 1,850 kilovolts: indium gives an activity of approximately 4 hours period, which is obviously due to the same metastable state ^{115}In*, of which we have already spoken. Similar results on the stable nuclear fluorescence of indium were obtained by Collins and others[19].

There is no doubt that new isomers of β-stable nuclei will be discovered, in the course of research undertaken in different laboratories; systematic research on the radiations emitted by metastable states will certainly be very useful for the understanding of nuclear isomerism.

In conclusion, we may remark that it is very probable, on account of the great number of known isomers, that the radiative transitions of life-times between, say, 10^{-7} sec. and 1 sec. are much more frequent than is generally supposed. These transitions, on the other hand, are strongly converted[6]. We would expect[20], consequently, that *transitions of this kind, with conversion coefficients approximately* 1, *may be found frequently*.

Indeed, in the radiation emitted in the capture of slow neutrons by gadolinium, a strong component of soft electrons has been observed by Amaldi and Rasetti[21] (life-time less than 10^{-9} sec.). Soft electronic components have also been observed in the capture of slow neutrons by other nuclei[22]. On the other hand, these strongly converted transitions may play a considerable part in the interpretation of γ- and X-spectra emitted by certain natural radio-elements[20].

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RECENT ADVANCES IN RADIO ENGINEERING

RADIO MEETING IN WASHINGTON

A JOINT meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American Section) was held at Washington, D.C., during April 28–29, 1939. Twenty-four papers on the more fundamental aspects of radio communication were presented.

A paper of particular interest, by D. R. Goddard, RCA Communications, Inc., reported reception at Riverhead (Long Island), N.Y., of British television transmissions on 41·5 and 45·0 megacycles from Alexandra Palace, London. The British afternoon programmes, between 9.30 a.m. and 11.30 a.m. New York time, could be received at times during certain winter months with some clarity. The author showed motion picture reproductions of images received on a number of occasions, both clear and distorted. Multiple path transmission was believed to be responsible for some of the distortion. In the past few years, the latest date for which reception is possible has been steadily receding from March through February to January, and it seems probable that next winter no reception at Riverhead of these signals will be possible after December 31.

Prof. Leon Brillouin of the Collège de France presented a comprehensive theoretical discussion of the transmission of electromagnetic waves in hollow conductor pipes, and reported confirmatory experimental work. Pipes of elliptical cross-section have been investigated, as well as those of square cross-section. Acoustic analogies, as discussed by M. Brillouin (*J. Phys.*, 1906), have been found of material assistance in these studies. An application of this investigation is to the design of tuning units of small attentuation for very high frequencies.

W. E. Jackson, of the U.S. Civil Aeronautics Authority, described the use of ultra-high frequencies, as 63 megacycles, in radio aids to air navigation. These frequencies reduce multiple course indications, and are particularly suitable for aircraft application where usual horizon limitations do not apply.

H. T. Stetson, of the Massachusetts Institute of Technology, reported corroboration of a lunar effect of radio transmission which he discovered and published several years ago. A large number of observations have been examined, and appear to yield fairly consistent results among themselves, indicating increased field strengths as the moon nears the meridian. Reference was made to a discussion of lunar effects by Appleton (NATURE, July 9, 1938, p. 71).

B. Trevor, of RCA Communications, Inc., reported measurements of attenuation at 500 megacycles and 250 megacycles through 500 feet of woods and underbrush, also over low scrub pines.

J. T. Henderson, J. W. Bell and H. R. Smyth, of the National Research Council of Canada, described a 12-inch cathode-ray direction finder and its application to determine the direction of atmospherics. A cathode-ray direction finder equipment, received some time ago from the Radio Research Board of Great Britain, was used at Ottawa. At Forrest, Manitoba, a newer direction finder, designed and constructed by the authors, was used, and avoided defects found in the older instrument. Observers in Florida and Puerto Rico co-operated, particularly in studies of hurricane disturbances. While it is not yet possible to locate storms by these directional observations of atmospherics, before the Weather Bureau locates them by aeroplane observations, such early location of storms is an object of the work.

S. S. Kirby and F. R. Gracely, of the U.S. National Bureau of Standards, reported comparisons of signals at broadcast frequencies received at Washington from Buenos Aires with signals received from Rennes, France, and other European stations. The measurements have usually been made from 1 to 3 a.m. Washington time. The South American path averages about twenty times as good as the European path, both as to average field intensity and as to range of night-to-night variations of field intensity. The observed transmitting conditions were compared with co-existing magnetic disturbances, and it appears that the poor transmitting conditions on the northern path (auroral zone) may persist several days after the magnetic disturbance has ceased, the day following cessation of the magnetic disturbance often being particularly bad.

Ralph Stair and W. W. Coblentz, of the U.S. National Bureau of Standards, described a precision instrument sent aloft with balloons for observing and reporting to the ground the distribution of ozone in the stratosphere. There is used a precision method of making such measurements by measuring the change in spectral distribution of ultra-violet solar radiation at different heights as the balloons rise. Measurements of intensity in the ultra-violet are made by a special cadmium photo-electric cell which covers the range from about 2800 A. to 3300 A., and these are transmitted to the ground by a small radio transmitter including a relaxation oscillator. The instrument has been described in the March 1939 *Bureau of Standards Journal of Research*. It has been sent up to heights of 27 km.; about two-thirds of the total ozone lies below this height. Maximum ozone content has been found at heights of about 25 km.

Andrew Alford, of Mackay Radio and Telegraph Co., reported studies at high frequencies of characteristics of antenna arrays. He described marked differences in the phase of signals received over relatively long distances from two similar transmitting antennæ, only a few hundred feet apart, operating at the same time on the same frequency. The keying of the two transmitters was interlocked, and the signals were received and compared at the receiving station as to phase and intensity on a cathode-ray oscillograph. It appears that the construction of a directive transmitting array to obtain gain may fail of its purpose if the signals from different antennæ arrive out of phase, due to transmission over different paths. Proper phasing of inputs at the transmitting array may be an effective control, to get proper co-operation between the different antennæ.

R. C. Colwell and A. W. Friend, of the University of West Virginia, reported studies of tropospheric

reflections at about 2,400 kc. Preliminary tests in conjunction with data from simultaneous aeroplane flights indicate direct connexion with temperature and humidity variations in the troposphere, as reflection at a temperature front. These reflections may be susceptible of use for weather prediction, both for primary data in localities where neither aeroplane flights nor *radio sonde* ascents are available, and also as secondary data to interpolate between such regular flights and ascents at established stations (see NATURE, July 1, 1939, p. 31).

L. V. Berkner, of the Carnegie Institution of Washington, who has just returned from an extended visit to Australia, described foreign installations and technique for ionospheric exploration. Observations at the Watheroo (Western Australia) station of the Carnegie Institution were discussed in particular detail, especially with reference to the formation of the *E*-region, and there was pointed out the importance of co-ordination of ionospheric measurements from a number of stations widely separated over the earth, and the extensions of ionospheric knowledge already so obtained.

N. Smith and A. S. Taylor, of the U.S. National Bureau of Standards, described a project now under way to predict monthly average ionospheric characteristics and maximum usable frequencies for undisturbed days, for several months in advance. Such predictions are now being published each month in the *Proceedings of the Institute of Radio Engineers*. These predictions are related to sunspot numbers.

J. A. Pierce and H. R. Mimno, of Harvard University, reported on the reception of radio echoes from distant ionosphere irregularities. Studies of numerous reflection patterns strongly indicate that the delayed echoes are returned from regions where there is a marked curvature of the *F*-layer, as at the edge of the sunlit zone. There may be successive reflections between the *E* and *F* layers.

Other papers covered a comprehensive study of the characteristics of noise in radio reception, a field strength survey on 52·75 megacycles in the New York area, transmission on 7 megacycles between Los Angeles and San Francisco, a comparison of shunt and series excitation of a 0·55 wave-length uniform cross-section broadcast vertical radiator, inductive output tubes, shielding of radio-frequency ammeters, and additional ionosphere studies.

The meeting was preceded and followed by a number of informal round-table discussions of groups specialized in certain aspects of ionosphere and transmission phenomena. It is expected that a number of the papers presented will be published in the *Proceedings of the Institute of Radio Engineers*.

BEIT MEMORIAL FELLOWSHIPS FOR MEDICAL RESEARCH

A MEETING of the trustees of the Beit Memorial Fellowships for Medical Research, Sir Alfred Beit, the Earl of Onslow, Lord Harlech, Lord Rayleigh, Lord Macmillan of Aberfeldy, Prof. T. R. Elliott and Dr. H. L. Eason, was held on July 19, 1939. They received with regret the resignation from the advisory board of Sir F. Gowland Hopkins, who throughout the long period of twenty-five years has given wise counsel at the meetings of the Board and in his Biochemical Department at Cambridge has directed the research studies of perhaps a greater proportion of those elected to Beit Fellowships than any other head of a department has done. They also regretted the resignation of Sir Patrick Laidlaw after eight years of keenly attentive work. These vacancies were filled by the appointment to the Board of Prof. R. A. Peters, Whitley professor of biochemistry, University of Oxford, and of Dr. Paul Fildes, bacteriologist on the scientific staff of the Medical Research Council.

Former holders of fellowships have recently received appointments as follows: C. H. O'Donoghue (fellow 1912–13) to be professor of zoology at the University of Reading; J. T. Irving (fellow 1926–28), to be professor of physiology in the University of Cape Town, South Africa; G. F. Marrian (fellow 1927–30) to be professor of chemistry in relation to medicine in the University of Edinburgh; F. H. Smirk (fellow 1930–34), to be professor of medicine in the University of Otago, New Zealand; and H. P. Himsworth (fellow 1932–35), to be professor of medicine in the University of London and director of the Medical Unit at University College Hospital.

It was in 1910 that the first Beit fellow, now Sir Thomas Lewis, was elected, and last year's election in 1938 brought the total of all fellows elected to exactly 200. Women are eligible and have been elected from 1910 onwards, their total being 30 out of the 200. Of the 170 men, 6 have been elected to the fellowship of the Royal Society, and no fewer than 34 have already been appointed to university professorships, of which 5 were in physiology, 5 in pharmacology, 5 in medicine and 9 in chemistry or biochemistry. Eight of these past Beit fellows hold professorial chairs in the Dominions over-seas. None of the women has yet been promoted to a university professorship, though at least six of them are doing work of much distinction and one has for some years been director of an important research laboratory. The opportunities for a woman to obtain a university chair in a scientific subject are still restricted.

Though the Beit fellows have come from all parts of the British Empire and have afterwards gone to laboratory posts all over the world, in their choice of a place of research during their fellowships they have tended to group themselves at three main centres. Out of the total 200, the laboratories at Cambridge have held 55, and 29 of these were personally directed by Sir Gowland Hopkins in the great Biochemical School that he developed in the Dunn Laboratories immediately after their opening in 1925. University College and University College Hospital in London together have provided opportunities for the work of 39. The Lister Institute of Preventive Medicine has accepted 35. The trustees have expressed their gratitude to the directors of these and of the other laboratories in Great Britain and elsewhere who have not only guided the work of the Beit fellows attached to them, but also provided the laboratory cost of that work.

The original Trust in London was founded by Sir Otto Beit as a memorial to his brother, Alfred Beit, a colleague of Cecil Rhodes in his great plans for the future of British South Africa. The names of both these brothers, members of a German family from Hamburg who later received British naturalization, will live in their benefactions for the advantage of the Empire. Mr. Alfred Beit left large sums for South African universities, and also founded a trust for the development of communications in South and Central Africa. This trust has been of material assistance in the development of Rhodesia. Empire Day, 1939, saw the opening of a great bridge 500 yards long over the Zambezi, north-west of Salisbury and joining the two Rhodesias. The gift of this "Otto Beit Bridge" costing £180,000 came ten years after the building of the "Alfred Beit Bridge" at a cost of £130,000 over the Limpopo farther south; and much besides has been granted by this trust for other bridges, for education, school buildings, maternity homes, and other social services.

The Beit Trust for Medical Research, which is established in London, cannot afford such material evidence of its benefits, though actually a total of nearly £190,000 has been disbursed in fellowships since 1910. But the foregoing summary of the positions now held by past Beit fellows, men and women drawn from all parts of the Empire, shows how great and widely spread have been the intellectual gains through these fellowships. They have enabled men to live for three or four years whole-heartedly in an environment of research and by so doing to learn to devote the rest of their lives to scientific thought.

All correspondence of fellows and candidates should be addressed to Prof. T. R. Elliott, Honorary Secretary, Beit Memorial Fellowships, University College Hospital Medical School, University Street, London, W.C.1.

The following elections to new fellowships were made:

Fourth Year Fellowships (£500 a year): Dr. I. Berenblum, to continue his work on the production of cancer by skin irritants, and to study the metabolism of living cells in tissue culture (School of Pathology, University of Oxford); T. A. H. Munro, to continue his studies of the role of inheritance in mental disorders (Royal Eastern Counties Institution, Colchester); Dr. A. Neuberger, to extend his work on the chemistry of amino-sugars in elucidation of the structure of natural compounds (Department of Pathological Chemistry, University College Hospital Medical School, University of London); Dr. R. J. Pumphrey, to continue his studies on the nervous system of cephalopods and on the auditory processes in insects (Zoological Laboratory, University of Cambridge, and the laboratory of the Marine Biological Association, Plymouth).

Junior Fellowships (£400 a year): Dr. V. H. Booth, for research on (1) the internal constituents of bacteria by means of a wet-crushing mill, (2) carbonic anhydrase (Physiological Laboratory, University of Cambridge); E. G. L. Bywaters, for research on rheumatoid arthritis (British Postgraduate Medical School, University of London); Dr. W. I. Card, for research on the inhibition of gastric motility and secretion by experimental studies on man (Medical Unit Laboratories and Sherrington School of Physiology, St. Thomas's Hospital Medical School, University of London); Dr. Hans Heller, for research on the antidiuretic principle of post-pituitary extract (Medical Unit Laboratories, University College Hospital Medical School, University of London); Dr. M. S. Jones, for investigations on insulin treatment of schizophrenic mental states (Maudsley Hospital, Denmark Hill, University of London); Dr. B. Levin, to investigate the effect of spatial configuration of antigens on immunological reactions (Clinical Chemical Laboratories, London Hospital, University of London); I. Mackenzie, for immunological investigations on constituents of tumours (Department of Surgical Research, University of Edinburgh); Dr. A. F. Rawdon-Smith, for research on congenital deafness (Physiological Laboratory, University of Cambridge); Dr. B. R. Record, to investigate the specific soluble substance found in the tissues in acute vaccinial infection (Lister Institute of Preventive Medicine, University of London).

TRENDS OF PROGRESS IN TECHNICAL CHEMISTRY

THE annual meeting of the Society of Chemical Industry, held at Exeter on July 10–15 under the presidency of Dr. V. G. Bartrow, the eminent Canadian industrial chemist, was noteworthy for a symposium on "The Trend of Progress" to which important papers on various subjects in the field of chemical technology were contributed (*J. Soc. Chem. Ind.*, **58**, 587, 613, 635; 1939).

P. W. Tainsh (chief chemist to Lever Bros., and Unilever, Ltd.) reported on progress in oils, fats (other than edible) and detergents, pointing out that during the last twenty years important advances have been made in the methods of treating oils and fats to render them suitable for soap-making, and in particular bleaching and hydrogenation processes have been remarkably improved. The main development in connexion with the technical bleaching of oils has been in the application of activated bleaching earths. At one time the bleaching of oils was mainly carried out with natural earth, such as fuller's earth, and with this the bleaching effect obtained with an oil such as palm oil, for example, was strictly limited. Activated earths are obtained by treating the natural earths with hydrochloric or sulphuric acid and washing the earth down to a limited free-acid content. Tallow is still bleached for soap-making purposes by treatment with activated carbon after neutralization.

The progress made in technical hydrogenation during the last ten or fifteen years has been of great benefit to the soap-maker, and the hardened product may be so controlled that suitable artificial fats may be obtained from such materials as whale oil and fish oils which are equal in all respects, and for some purposes superior, to tallow. The use of preservatives in preventing oxidation has been developed. Improvements in soap-making, drying and milling soap, the production of soap powders and soap products, are recorded. One of the latest developments is that of

the so-called soapless detergents. Normal soaps are sodium and potassium salts of long-chain carboxylic acids. In soapless detergents the long hydrocarbon chain is retained, but by the introduction of a variety of solubilizing groups other than the simple carboxyl group, products are obtained which are not affected by hard water. Such products are sulphated higher alcohols (C_{12} to C_{18}), condensation products of fatty acids with isethionic acid, products of interaction of fatty acid chlorides and methyl taurine, and of the fulphonation of the product from high molecular weight phenols and ethylene oxide. Many of these products are in industrial use, although for general purposes it would appear that the newer detergents are still inferior to soap.

The trend of progress in cosmetics was reported by H. S. Redgrove. Titanium oxide may replace zinc oxide as a white face-powder. Lake colours and synthetic iron oxides are used for tinting, cellulose nitrate nail enamel has replaced wax and powder polishes. Other topics dealt with included hair dyes and creams, shampoos (including soapless products) and face creams.

The cellulose industry, with special reference to the paper and allied industries, was dealt with by J. Grant (chief chemist to J. Dickinson and Co.). Cellulose derived from wood takes the first place among the raw materials, although esparto grass is widely used in Great Britain for printing papers. Originally, three main processes were used for producing wood pulp: the acid process (sulphite pulp), the alkaline process (kraft pulps), and the mechanical process (for newsprint). The paper manufacturer is now met in competition in the pulp market by the makers of rayon (artificial silk), plastics and explosives. Other types of wood are now being investigated, and in Germany the exploitation of beech wood has been fostered by a nationalistic policy and is now reaching considerable proportions, and esparto from Italian North Africa is now being exploited in Italy, where sunflower stalks, hemp stalks and straw are also making the country largely independent of outside supplies. A combination of the two previously separated processes of isolation and bleaching is now occupying the cellulose industry, one process being chlorination with elementary chlorine. This enables fibres to be used which were previously unsuitable for paper pulp. A process still undeveloped commercially is the extraction of impurities from mildly processed raw material by means of organic solvents.

The cellulose textile industry was discussed by H. A. Thomas (of Messrs. Courtaulds, Droylsden) under the headings of production, dyeing, finishing and testing. Various modifications in the properties of the viscose fibre are possible in new processes, some varieties, for example, being suitable for motor tyre cords, which have to withstand temperatures in the region of 100°, and also the fibres imitating wool. Modifications in the acetylation of cellulose for the production of acetate rayon include the use of special solvents which are miscible with the esterifying agents, but prevent dissolution of the cellulose ester. In the dyeing section, an important trend is the production of coloured yarn by the incorporation of insoluble pigments in a finely dispersed form in the rayon spinning mass, a process known as spin-dyeing. This is overcoming the difficulty of producing fast shades on acetate rayon. Suitable pigments are carbon black and organic fast pigments. In the finishing section, the use of crease-resisting finishes by suitable impregnation of the fabric with solutions which on heat treatment produce a resin or polymer *in situ*, is extending. The technique of stiffening fabrics by employing cellulose esters or ethers, either as an interlayer or as woven threads, which are then plasticized and hardened, is used for semi-stiff shirt collars and cuffs. Viscose staple fibre is finding an increased use in the cotton trade.

In a paper on insecticides by J. T. Martin and F. Tattersfield (of Rothamsted Experimental Station) it is pointed out that the use of these materials has very greatly increased in recent years. The older products are still of great importance, although the supremacy of some has been challenged. Among stomach poison insecticides, lead arsenate has so far withstood all attempts to replace it. Of the many hundreds of synthetic compounds tested, phenothiazine (thiodiphenylamine) has aroused the greatest interest; among other things it is a potent poison for the mosquito larva. Nicotine bentonite is effective against codling-moth. The use of glycero-borates as a dressing in the treatment of blow-fly on sheep has given very satisfactory results. The application of various fluorine derivatives, including sodium silicofluoride, as moth proofing of fabrics gives satisfactory results. Among contact insecticides, nicotine, rotenone-containing plants, pyrethrum, quassia and petroleum are predominant, and recent progress is mostly concerned with their chemistry, mode of application and range of utility. The development of winter washes as ovicides has been a marked feature of the last twenty years. Experiments indicate that some insect pests can become highly resistant to the toxic substances used in their extermination.

Fungicides are reported upon by H. Martin (Research Station, Long Ashton, Bristol). Attention has been given to the factors affecting the efficiency of fungicidal treatments, such as the amount of fungicide retained on the treated plant or seed. This is connected with the wetting properties of the spray. Instead of water, a carrier of the active spray ingredient may be a liquid of low surface tension exhibiting low contact angles, such as kerosene and aqueous solutions of surface-active materials. Another promising method is to dissolve the active constituent in an oil and then emulsify this in an aqueous phase; an example is a nicotine - cottonseed oil - Bordeaux spray. The number of established active constituents of fungicides is limited to sulphur, copper, mercury, formaldehyde, and a few less widely used materials, and recent experimental work has modified generally accepted views of the action of these.

The paper of Sir John Russell (director of the Rothamsted Experimental Station) on crop production dealt with new crops, such as sugar beet, mechanization, increasing grass land, and the fertility of British soils. Sir John finds no evidence for the deterioration of British soils. The effects of small quantities of boron, manganese, copper and zinc in plant nutrition is now recognized, and other elements such as cobalt, molybdenum, selenium, fluorine and iodine in appropriate quantities considerably influence the nutritive value of the crop and animals. The question of the effect of reduced production of farmyard manure on soil fertility is answered by the statement that there is no evidence that it has lowered the fertility of British soils; there has been a corresponding shrinkage in area of arable land, and the grassland which has replaced it does not need farmyard manure.

GEOTHERMIC POWER IN ITALY

THE formation of a large company in Italy—Larderello S.A. per lo Sfruttamento delle Forze Endogene—with a capital of 54, and perhaps later of 150, million lire, for utilizing the natural heat sources of Italy, may well be regarded as a consummation of the life work of Prince Ginori Conti. He is honorary president of the new company which has taken over many of his patents together with his company, the Societa Boracifera di Larderello; and among other distinguished people on the board of directors is Dr. G. Fauser, the inventor of the well-known electrolytic cell.

In a small book published last year, Prince Conti described his new and well-equipped laboratory for research in this field, which he says dates back to 1906, and is a continuation of "the long and noble tradition" originating with Höfer who, in 1777, discovered boric acid in the Lagon Cherchiaio di Monterotondo. In 1916 was established the first and still probably the only Centrale Geotermica in the world, developed later into a Supercentrale of some 90,000 kw. The yield of gas and fume from the fumaroles (Ital. fumaioli or fumaruoli) and soffioni has increased very remarkably from a few hundred thousand kilos to two million kilos of fume or vapour per hour, besides enormous quantities of gas. The latter occurs in the proportion of about 30 litres gas to 1 kilo of fume, and consists of 93 per cent carbon dioxide, 2·5 per cent hydrogen sulphide, and combustible residue the composition of which is approximately 38 per cent hydrogen, 39 per cent methane, 22·6 per cent nitrogen, together with small proportions of helium, neon, argon, krypton, and xenon.

A well-equipped research station has for some time been engaged on the analysis and industrial possibilities of these various products.

The work is under the personal supervision of Prince Conti, with the assistance of his son, Dr. Giovanni Ginori Conti, Prof. Umberto Sborgi and other distinguished Italian men of science and engineers. The organization comprises library, administrative offices, and various departments for chemical, physical, geological, mineralogical, geophysical, and seismographical investigations, not only in connexion with the fumaroles and soffioni but also of the 'boric acid fields' around Larderello. Since the operations of the new company extend to the whole of Italy other similar research stations will doubtless be established in other districts, with Larderello as headquarters. Provision is made, *inter alia*, for high- and low-temperature and high-pressure investigations, the former ranging from −254° to 2000° C. and the latter up to 1000 atmos. Semi-large scale working is also included, and a pilot plant has been installed for dealing with 150 cu. m. per hour. Among the principal items in the research programme at present are the recovery of helium and other rare gases, also of hydrogen, methane, and a synthesis gas mixture of hydrogen and nitrogen, presumably for ammonia production and derivatives, such as nitric acid, etc.

TRAINING OF ENGINEERS

IN the June issue of the *Journal of the Institution of Civil Engineers* is published the record of a joint informal meeting of the three Institutions—Civil, Mechanical and Electrical—at which Mr. T. G. Rose introduced the subject "The Importance of a Training in Management for Engineers". Following the two claims (1) that the fundamental principles governing sound industrial management were now sufficiently clearly defined to be teachable, and (2) that a knowledge of these principles would be of advantage to an engineer in the pursuit of his profession, he indicated several systems on which the desired instruction might be given.

That the need of this is keenly realized was made evident by the brisk discussion, but the views expressed were very divergent as to how and when the training should be given. Some considered that it could only be usefully imparted to those who had had experience, while others held that the principles could be taught at an early stage. One suggestion was that the three Institutions should arrange lectures and meetings at which the problems of industrial management would be discussed by practical men. This would, no doubt, provide a finishing course which could be read and studied by all those, wherever situated, who had already been taught the fundamental principles. No clear indication was given as to the method of providing this elementary instruction, but there was a suggestion that it might form part of the production side of the National Certificate scheme. This, however, is already heavily burdened and a little consideration will show that, unless the subject is made optional, it will to some proportion of the students be a distinctly unwelcome one forced upon them.

In the same issue of the *Journal* it is interesting to note the intimation that the Council will promote a conference on engineering education and training during the course of next session and has invited the universities and other bodies to appoint representatives to form a general organizing committee. The time is ripe for such a conference, for it is nearly thirty years since the last, and one would expect that, to ensure steady development, five-yearly conferences would be held. At present it is very largely left to the colleges themselves to devise systems and curricula, and the several branches of the profession take but a perfunctory interest in a matter so closely affecting them. In consequence, there is a very large class of students whose interests are wholly neglected by the Institutions. This class consists of all those who are outside the reach of the recognized colleges, and for whom some authoritarian training should be envisaged as at present is provided for those more fortunately placed. Some responsibility rests on those who control the National Certificate arrangements in respect of the thousands of students who are, in effect, barred from them.

SCIENCE NEWS A CENTURY AGO

Baron de Prony, 1755-1839

ON July 29, 1839, the distinguished French mathematician and engineer, Gaspard-Claire-François-Marie-Riche, Baron de Prony, died at Asnières, near Paris, at eighty-four years of age. For many years he had been the senior member of the Corps des Ponts et Chaussées and was famous both as a writer and a constructor. Born near Lyons on July 11, 1755, he had been trained under Perronet, "the Telford of France", at the École des Ponts et Chaussées, and afterwards became his assistant. With Perronet, too, he visited England. During the Revolutionary era, Prony formed one of the commission entrusted with the reformation of the French weights and measures and with the great survey of France. In connexion with this he organized and trained a body of computers for forming the logarithmic tables required, the result being seventeen large volumes of tables, afterwards deposited in the Paris Observatory. In 1798 he was raised to the rank of inspector-general in his corps and soon afterwards succeeded Chezy as director of his old school.

Though he declined to join the group of scientific men who accompanied Napoleon on his expedition to Egypt, Prony was employed by Napoleon on many considerable works in Italy, and with Count Fossombroni was entrusted with the drainage and improvement of the Pontine Marshes. His principal literary work was his "Nouvelle architecture hydraulique" published in 1790–96. He was one of the first professors of the famous École Polytechnique and one of the first members of the Institut de France. In 1817 he was made a member of the Bureau des Longitudes, in 1818 the Royal Society elected him a foreign member, in 1827 he was made a baron and seven years later a peer of France.

Dumont d'Urville's Voyage in the *Astrolabe*

ON July 30, 1839, Captain Dumont d'Urville wrote from the *Astrolabe*, then at the island of Mindanao: "Our navigation since the 2nd of July, the day of our departure from Singapore, has been fertile in results. We have touched at Sambas, in the island of Borneo, closely reconnoitred the islands of Natunas, Balambangan, Banguey, and the northern portion of Borneo. Finally we have passed four days in the road of Sooloo. The people of these several places have acquired from our communications clearer notions in relation to the flag and power of France: they desire much to see the rest of our ships. I am about to spend a week at Samboangan. I shall depart there on the 6th of August, and reckon on reaching Port Jackson about the middle of December."

Society for the Diffusion of Useful Knowledge

ON August 2, 1839, this Society sent out a letter from its headquarters, 59 Lincoln's Inn Fields, London, signed by Lord Brougham, which said: "It is the wish of the Committee of the Society for Diffusion of Useful Knowledge, to establish a correspondence among the various Mechanics' Institutions in England, and between them and this Society, so that neighbouring institutions, by dividing the travelling expenses of lecturers among them, may diminish the cost of each course of lectures; that one set of apparatus, or collection of models or specimens of natural history, or even one set of books, may serve for many institutions; and that local collections and duplicates from libraries and museums, may be interchanged all over the country".

By the issue of an annual report, correspondence and the interchange of suggestions, it was hoped to make the experience of one institution serve as a guide to others, and by collecting information to be able to issue an annual summary on the progress of adult education in Great Britain.

To further these objects, the Society called a meeting of representatives of institutions in London and neighbourhood which was attended by about forty, when a committee of delegates was appointed.

The Society for the Diffusion of Useful Knowledge existed from 1827 until 1846. It published a series of cheap books on science, history and literature, and also the *Penny Cyclopædia*.

UNIVERSITY EVENTS

EDINBURGH.—At the graduation ceremonial on July 19 the honorary degree of doctor of laws was conferred on Dr. F. H. A. Marshall, fellow and dean of Christ's College, Cambridge, and reader in agricultural physiology in the University of Cambridge. On the previous day, Dr. Marshall declared open in the Edinburgh University Settlement the Wilkie Memorial Library, which has been established in recognition of the great interest which the late Sir David Wilkie and Lady Wilkie took in the work of Settlement.

LEEDS.—Dr. E. C. Stoner, reader in physics, has been elected to the recently instituted chair in theoretical physics.

The following appointments have also been made: Dr. N. H. Chamberlain to be lecturer in textile chemistry; Arthur Johnson to be assistant lecturer in weaving mechanism; Dr. C. S. Whewell to be assistant lecturer in finishing and research assistant in the Textile Department; J. W. Roderick and W. A. Linning to be lecturers in engineering; J. F. Gaunt to be research assistant in dyeing; Dr. J. Stubbs to be temporary research assistant (for bracken investigation) in the Agricultural Department.

Prof. F. A. E. Crew, director of the Institute of Animal Genetics, Edinburgh, has been invited to deliver the Clive Behrens Lectures in the Agricultural Department during the two years 1939–1941.

LONDON.—W. G. Barnard has been appointed, as from October 1, 1939, to the University chair of pathology tenable at St. Thomas's Hospital Medical School. Since 1931 he has been consultant histologist to the London County Council and pathologist-in-charge of the London County Council Central Histological Laboratory, Archway Hospital.

The title of reader in medicine in the University has been conferred on Dr. E. F. Scowen in respect of the post held by him at St. Bartholomew's Hospital Medical College.

The degree of D.Sc. have been conferred on the following: Miss Daphne Atkins (Bedford College), Miss M. C. Brough (University College), Dr. W. H. Linnell, University reader at the College of the Pharmaceutical Society, and J. A. B. Smith (Imperial College of Science and Technology).

R. M. Calder has been re-appointed to the Graham scholarship in pathology for a further period of one year from November 1, 1939.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

PRINCIPAL TECHNICAL OFFICER and a SENIOR TECHNICAL OFFICER at Air Ministry Headquarters—Under-Secretary of State, Air Ministry (S2A/B8019), Berkeley Square House, W.1 (August 4).

CHIEF ASSISTANT ENGINEERS—Clerk of the County Council, County Buildings, Stafford (August 5).

ASSISTANTS Grade III—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. (quoting A340.0) (August 11).

TECHNICAL OFFICER—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting A399.0) (August 12).

ASSISTANT LECTURER IN BOTANY (Grade III)—Registrar, University, Liverpool (August 15).

LECTURER IN ANATOMY—Secretary to the University, Aberdeen (August 18).

PHYSICAL CHEMIST—Director of Research, Research Association of British Flour-Millers, Old London Road, St. Albans (August 19).

LECTURER IN BIOLOGY—Secretary, Royal (Dick) Veterinary College, Summerhall, Edinburgh 9 (August 20).

WATERWORKS ENGINEER—Town Clerk, Town Hall, Bradford (August 28).

LECTURER IN ELECTRICAL ENGINEERING—Secretary, University, Edmund Street, Birmingham 3 (August 30).

DEMONSTRATOR IN PHYSIOLOGY—Registrar, University, Liverpool (September 1).

LECTURER AND STUDIO-INSTRUCTOR (Ungraded) IN ARCHITECTURE—Registrar, University, Liverpool (September 18).

HEAD OF THE PHYSIOLOGY DEPARTMENT—Secretary, Rowett Research Institute, Bucksburn, Aberdeenshire (September 30).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The National Central Library. 23rd Annual Report of the Executive Committee, 1938–39. Pp. 77. (London: National Central Library.) [127

Permanent Consultative Committee on Official Statistics. Guide to Current Official Statistics of the United Kingdom. Vol. 17 (1938): Being a Systematic Survey of the Statistics appearing in all Official Publications issued in 1938. Pp. 404. (London: H.M. Stationery Office.) 1*s.* net. [127

The Strangeways Research Laboratory. Report for 1938. Pp. 24. (Cambridge: Strangeways Research Laboratory.) [137

Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences. Vol. 229, No. 564: Fused Neurons and Synaptic Contacts in the Giant Nerve Fibres of Cephalopods. By John Z. Young. Pp. 464–503+plates 42–48. (London: Cambridge University Press.) 15*s.* [147

New Zealand Council for Educational Research. Studies in Education, No. 4: Science and the Community. By Prof. Alexander Findlay. Pp. 18. (London: Oxford University Press.) 1*s.* net. [147

City of Gloucester: Public Museum and Folk Museum. Short Guide to the Collections. Pp. 20. (Gloucester: Public Museum.) 3*d.* [147

Air Raid Precautions. Handbook No. 11: Camouflage of Large Installations. Pp. v+15. (London: H.M. Stationery Office.) 3*d.* net. [157

Statements relating to the Emergency Hospital Organisation, First Aid Posts and Ambulances. (Cmd. 6061.) Pp. 23. (London: H.M. Stationery Office.) 4*d.* net. [157

How to Stock your A.R.P. Larder: One Week's Emergency Food Store chosen by the *British Medical Journal*. Pp. 12. (London: British Medical Association.) 2*d.* [177

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 3, No. 28: The Arrangement of Fibre Follicles in some Mammals, with Special Reference to the Ovidæ. Being selected and illustrated Notes made by the late Dr. J. E. Duerden, compiled by Dr. A. B. Wildman. Pp. 763–771+4 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 2*s.* 6*d.* [187

Cambridge Observatory. Annual Report of the Director, 1938 May 1–1939 April 30. Pp. 4. (Cambridge: Cambridge Observatory.) [187

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 6: Carbon Bisulphide Vapour. Pp. iv+8. (London: H.M. Stationery Office.) 3*d.* net. [197

Air Ministry: Aeronautical Research Committee. Report for the Year 1938. Pp. 48. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [217

Other Countries

The Greatest Discovery of the Age. By Raj Vaida Anand Swami. Pp. 26. (Colombo: Kaya Kalpa Kanan (Rejuvenation Home).) 3 annas. [107

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 175: Flight Tests on the Range of the Kōken Long-Range Monoplane. By Hidemasa Kimura and Tatuo Takatuki. Pp. 127–148. 50 sen. No. 176: On Direction Finder. By Daiso Nukiyama, Mitsunobu Irisawa and Tasaburo Kobayasi. Pp. 149–192. 70 sen. (Tōkyō: Kōgyō Kosho Kabushiki Kaisha.) [137

Indian Lac Research Institute. Bulletin No. 33: Studies on the Constitution of the Shellac Complex. Part 1: Interaction of Tolyliodochloride with Shellac. By M. Venugopalan, H. K. Sen and S. C. De. Pp. 14+5 plates. 3 annas. Bulletin No. 34: Studies on the Constitution of the Shellac Complex. Part 2: Unsaturation in Shellac. By Y. Sankaranarayanan, M. Venugopalan, S. C. De and H. K. Sen. Pp. 8+2 plates. 3 annas. (Namkum: Indian Lac Research Institute.) [137

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Magnetisk Aarbog, Del 2: Grønland, 1932–1933. Pp. 22+xxviii+9+xxviii. (København: G. E. C. Gad.) [157

Sveriges Geologiska Undersökning. Ser. C, No. 419: Berggrunden inom sydöstra delen av Stockholms skärgård. Av Nils Sundius. Pp. 93. 2.00 kr. Ser. C, No. 423: Sjösediment från området Abisko-Kebnekaise. Av G. Lundquist. Pp. 127. 2.00 kr. Årsberättelse för år 1938. Pp. 8. 0.50 kr. (Stockholm: P. A. Norstedt and Söner.) [177

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 17, No. 4: The Swedish Ordovician and Lower Silurian Lichida. By Elsa Warburg. Pp. 162+14 plates. Serien 3, Band 17, No. 5: Studies in Species of Lecanora, mainly the *Aspicilia gibbosa* Group. By A. H. Magnusson. Pp. 182. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [177

Coconut Research Scheme (Ceylon). Bulletin No. 3: Annual Reports of the Soil Chemist for the period July 1933 to December 1937. By Dr. M. L. M. Salgado. Pp. iv+76. (Lunuwila: Coconut Research Scheme.) [177

British Honduras. Report of the Forest Department for the Year ended 31st December 1938. Pp. 25. (Belize: Government Printer.) [177

Ceylon. Part 4: Education, Science and Art (F.). Administration Report of the Director of the Colombo Museum for 1938. By A. H. Malpas. Pp. F19. Colombo: Government Record Office.) 20 cents. [177

Zoological Survey of India, Calcutta. Consolidated Report on the Shell-Fisheries in the Andamans during the Years 1930–35, with Extracts from Earlier Reports. Pp. v+130+2 plates. (Delhi: Manager of Publications.) 4.5 rupees; 8*s.* 3*d.* [177

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1931–1932. English Version, Part 1. Pp. 102+24 plates. (Cairo: Government Press.) P.T.50. [187

League of Nations: Advisory Committee on Social Questions. Study on the Legal Position of the Illegitimate Child. (Official No.: C.70. M.24. 1939. IV.) Pp. viii+194. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 4*s.* [187

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 198: A Yield Analysis of Egyptian Wheats. By Dr. James Philip. Pp. ii+22+5 plates. P.T.3. Bulletin No. 207: Biological Studies of some Hymenopterous Parasites of Aphidophagous Syrphidæ. By Dr. M. Kamal. Pp. ii+111. P.T.10. (Cairo: Government Press.) [197

The American Philosophical Society. Year Book 1938. Pp. 407. (Philadelphia: American Philosophical Society.) [197

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Smithsonian Institution: Bureau of American Ethnology. Bulletin 121: Archæological Remains in the Whitewater District, Eastern Arizona. Part 1: House Types. By Frank H. H. Roberts, Jr. Pp. xii+276+30 plates. 50 cents. Bulletin 123: Anthropological Papers. Pp. viii+305+32 plates. 60 cents. (Washington, D.C.: Government Printing Office.) [197

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 774: Geology and Ground-Water Resources of the Snake River Plain in Southeastern Idaho. By Harold T. Stearns, Lynn Crandall and Willard G. Steward. Pp. ix+268+31 plates. 1.25 dollars. Water-Supply Paper 826: Surface Water Supply of the United States, 1937. Part 6: Missouri River Basin. Pp. vii+376. 45 cents. Water-Supply Paper 827: Surface Water Supply of the United States, 1937. Part 7: Lower Mississippi River Basin. Pp. iv+173. 25 cents. Water-Supply Paper 829: Surface Water Supply of the United States, 1937. Part 9: Colorado River Basin. Pp. v+197. 30 cents. (Washington, D.C.: Government Printing Office.) [197

U.S. Department of the Interior: Office of Education. Leaflet No. 14: Pharmacy. By Walter J. Greenleaf. Revised edition. Pp. 22. 5 cents. Pamphlet No. 86: Per Pupil Costs in City Schools, 1937–38. By Lulu Mae Comstock. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.) [207

League of Nations: European Conference on Rural Life. Report of the Preparatory Committee on the Work of its First Session. Pp. 9. 6*d.* National Monograph 1: Finland. Pp. 59. 1*s.* 6*d.* National Monograph 2: Belgium. Pp. 66. 1*s.* 6*d.* National Monograph 10: The Netherlands. Pp. 55. 1*s.* 6*d.* National Monograph 11: Latvia. Pp. 92. 1*s.* 6*d.* National Monograph 12: Lithuania. Pp. 47. 1*s.* 6*d.* Technical Documentation No. 13: General Survey of Medico-Social Policy in Rural Areas. Pp. 46. 1*s.* Technical Documentation No. 15: Sickness Insurance and Rural Medical Assistance. Pp. 33. 9*d.* Technical Documentation No. 16: Intellectual Aspects of Rural Life. Pp. 56. 1*s.* Technical Documentation No. 17: Recreation in Rural Areas. Pp. 34. 9*d.* (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) [207

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Department of Agriculture, St. Lucia, 1937. Pp. v+45. (Castries, St. Lucia: Government Printing Office.) 6*d.* [217

League of Nations: Information Section. Questions, 12: World Health and the League. Pp. 44. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 6*d.* [217

Advisory Committee on Education. Staff Study No. 16: Public Education in the Territories and outlying Possessions. By Lloyd E. Blauch, assisted by Charles F. Reid. Pp. xv+243. (Washington, D.C.: Government Printing Office.) 35 cents. [227

RECENT SCIENTIFIC AND TECHNICAL BOOKS

Volumes marked with an asterisk (*) have been received at "NATURE" Office

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Applied Mechanics. Proceedings of the Fifth International Congress for Applied Mechanics, held at Harvard University and the Massachusetts Institute of Technology, Cambridge, Mass., September 12–16, 1938. Edited by J. P. Den Hartog and H. Peters. Demy 4to. Pp. xxxii + 748. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 30*s.* net.*

Borchardt, W. G. A School Certificate Trigonometry. Cr. 8vo. Pp. 308 + xxxii. (London : Rivington's, 1939.) With or without Answers, 4*s.*

Botezatu, N. Die Wahrheit in der Relativitätstheorie erklärung des Michelson-Versuchs (La verité dans la théorie de la relativité.) Med. 8vo. Pp. iv + 36. (Cluj : Buchdruckerei "Pallas", 1939.)*

Boucheny, G. Curiosités et récréations mathématiques. 8vo. Pp. 146. (Paris : Libr. Larousse, 1939.)

Brink, Raymond. Essentials of Analytic Geometry. Cr. 8vo. Pp. 233. (New York and London : D. Appleton-Century Co., Inc., 1939.) 9*s.*

Broglie, Louis de. Exposés de physique théorique. 25 : Le principe de correspondance et les interactions entre la matière et le rayonnement. (Actualités scientifiques et industrielles, 704.) Roy. 8vo. Pp. 170. (Paris : Hermann et Cie., 1938.) 70 francs.*

Brunet, Pierre. Publications de l'Académie International d'Histoire des Sciences. 1 : Étude historique sur le principe de la moindre action. (Actualités scientifiques et industrielles, 693.) Roy. 8vo. Pp. 114. (Paris : Hermann et Cie., 1938.) 30 francs.*

Caudwell, Christopher. The Crisis in Physics. Edited with an Introduction by H. Levy. Cr. 8vo. Pp. xvi + 246. (London : John Lane, The Bodley Head, Ltd., 1939.) 7*s.* 6*d.* net.*

Currier, Clinton Harvey ; Watson, Emery Ernest, and Frame, James Sutherland. A Course in General Mathematics. Revised edition. Demy 8vo. Pp. ix + 382. (New York : The Macmillan Company, 1939.) 13*s.*

Destouches, Jean-Louis. Exposés de physique théorique publiés sous la direction de Louis de Broglie. 26 : Les électrons lourds (mésotons). (Actualités scientifiques et industrielles, 729.) Roy. 8vo. Pp. 70. (Paris : Hermann et Cie., 1938.) 29 francs.*

Frank, Nathaniel H. Introduction to Mechanics and Heat. Second edition. Med. 8vo. Pp. xvi + 384. (New York and London : McGraw-Hill Book Co., Inc., 1939.) 18*s.*

Freeman, Harry. Mathematics for Actuarial Students. (Published for the Institute of Actuaries.) Demy 8vo. Part 1 : Elementary Differential and Integral Calculus. Pp. viii + 184. 9*s.* net. Part 2 : Finite Differences, Probability and Elementary Statistics. Pp. xiii + 340. 25*s.* net. (Cambridge : At the University Press, 1939.)*

Gonard, E., et Hiernaux, G. Complément au cours élémentaire de mécanique industrielle. 8vo. Première partie. Pp. 326. 37 francs. Deuxième partie. Pp. 216. 27 francs. (Paris : Libr. Dunod, 1939.)

Goulden, C. H. Methods of Statistical Analysis. Med. 8vo. Pp. viii + 278. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 17*s.* 6*d.* net.*

Haas, Arthur E., with the collaboration of **Freeman, Ira M.** Elementary Survey of Physics : a Non-Mathematical Presentation with a Special Supplement for Pre-Medical Students. Ex. Cr. 8vo. Pp. xii + 204. (London : Constable and Co., Ltd., 1939.) 7*s.* 6*d.* net.*

Hayter, C. G., and Hearley, M. J. G. A First Geometry. Cr. 8vo. Pp. 194. (London, Bombay and Sydney : George G. Harrap and Co., Ltd., 1939.) 2*s.* 9*d.*

Humby, S. R. Electricity and Magnetism for Students. Ex. Cr. 8vo. Pp. 319. (London : John Murray, 1939.) 6*s.* 6*d.*

Humphrey, D., and Baggott, E. A. Elementary Mechanics, with Hydrostatics. Cr. 8vo. Pp. xvi + 628. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1939.) 8*s.*

Lanchester's "Potted Logs" : a Concise Tabulation (Slide Rule Auxiliary) for Engineers. Parts 1 and 2. Cr. 8vo. Pp. 28. (London : Taylor and Francis, Ltd., 1939.) 2*s.*

Laporte, Marcel. Décharge électrique dans les gaz. (Collection Armand Colin : Section de physique, No. 216.) Gl. 8vo. Pp. 222. (Paris : Armand Colin, 1939.) 15 francs.*

Lines, L. Intermediate Solid Geometry. Being Chapters I–VIII of "Solid Geometry". Cr. 8vo. Pp. xvi + 132. (London : Macmillan and Co., Ltd., 1939.) 2*s.* 6*d.*

Miller, Frederic H. Calculus. Med. 8vo. Pp. xiv + 420. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 15*s.* net.*

Murray, H. D., and Spencer, D. A. Colour in Theory and Practice. Vol. 1 : General Theory. Demy 4to. Pp. xvi + 176 + 3 plates. (London : Chapman and Hall, Ltd., 1939.) 25*s.* net.*

Prost, Maurice. Travaux pratiques de physique : P.C.B., S.P.C.N., M.P.C. 2 : Optique, électricité. (Actualités scientifiques et industrielles, 731.) Roy. 8vo. Pp. 110. (Paris : Hermann et Cie., 1938.) 29 francs.*

Réunion Internationale de physique, chimie, biologie. Congrès du Palais de la découverte, Paris, Octobre 1937. 1 : Physique générale. Par P. Debye, F. Simon, M. Wiersma, Sir C. V. Raman, M. Polanyi, B. Van der Pol. Roy. 8vo. Pp. 80 + 4 plates. 29 francs. 2 : Physique nucléaire. Par N. Bohr, P. Scherrer, J. D. Cockcroft, W. Bothe. Roy. 8vo. Pp. 81–134 + 2 plates. 19 francs. 3 : Rayons cosmiques. Par J. Clay, P. M. S. Blackett, G. Lemaitre. Roy. 8vo. Pp. 135–172. 10 francs. (Actualités scientifiques et industrielles, 718–720.) (Paris : Hermann et Cie., 1938.)*

Rey, Aloys. Théoriques mécaniques : hydrodynamique, acoustique, exposés publiés sous la direction de Y. Rocard. 10 : Études sur l'écoute des sources sonores éloignées. (Actualités scientifiques et industrielles, 709.) Roy. 8vo. Pp. 86. (Paris : Hermann et Cie., 1938.) 29 francs.*

Rojansky, V. Introductory Quantum Mechanics. Med. 8vo. Pp. x + 544. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1939.) 22*s.* 6*d.* net.*

Scholz, Arnold. Einführung in die Zahlentheorie. (Sammlung Göschen, Band 1131.) Pott 8vo. Pp. 136. (Berlin : Walter de Gruyter und Co., 1939.) 1.62 gold marks.*

See, T. J. J. Wave-Theory ! Discovery of the Cause of Gravitation ! Magnetism, Electrodynamics, and other Forces of Nature obeying the Geometrical Law of the Inverse Squares ; with Complete Mathematical and Physical Analysis. Demy 4to. Book 1. Pp. xvi + 155. Book 2. Pp. 186. Book 3. Pp. 286. (London : Wheldon and Wesley, Ltd., 1938–1939.)*

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Spectroscopy and its Application. Proceedings of the Sixth Summer Conference on Spectroscopy and its Application. Held at the Massachusetts Institute of Technology, Cambridge, Mass., July 18–20, 1938. Cr. 4to. Pp. viii + 172. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 15*s.* net.*

Thomson, Godfrey H. The Factorial Analysis of Human Ability. Demy 8vo. Pp. xv + 326. (London : University of London Press, Ltd., 1939.) 16*s.* net.*

Thomson, G. P., and Cochrane, W. Theory and Practice of Electron Diffraction. Demy 8vo. Pp. xii + 334 + 10 plates. (London : Macmillan and Co., Ltd., 1939.) 18*s.* net.*

Walker, W. J. A Shorter School Geometry. Cr. 8vo. Pp. vii +256. (London: Mills and Boon, Ltd., 1939.) 4*s*.

Weber, Robert L., Compiled by. A Manual of Heat and Temperature Measurement. Demy 4to. Pp. vii +141. (Ann Arbor, Mich.: Edwards Brothers, Inc., 1939.) 2.85 dollars.*

Wieleitner, H. Algebraische Kurven. Teil 2. (Sammlung Göschen, Band 436.) Neudruck. Pott 8vo. Pp. 122. (Berlin: Walter de Gruyter und Co., 1939.) 1.62 gold marks.

Wieleitner, H. Geschichte der Mathematik. (Sammlung Göschen, Band 226, 875.) Neudruck. Pott 8vo. Band 1. Pp. 136. 1.62 gold marks. Band 2. Pp. 154. 1.62 gold marks. (Berlin: Walter de Gruyter und Co., 1939.)

Wilson, Guy M., Stone, M. B., and Dalrymple, C. O. Teaching the New Arithmetic. 8vo. Pp. 458. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 18*s*.

Woods, Roscoe. Analytic Geometry. Demy 8vo. Pp. xiii +294. (New York: The Macmillan Company, 1939.) 10*s*.

Engineering

Arup, O. N. Design, Cost, Construction and Relative Safety of Trench, Surface, Bomb-proof and other Air Raid Shelters. Feap. folio. Pp. 63. (London: Concrete Publications, Ltd., 1939.) 6*s*. net.

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